

177281

EMPIRICAL SWEEP WIDTH ANALYSIS (AIR TO SURFACE)

SIO Ref. 68-30

OCTOBER 1968

William Hadley Richardson

UNIVERSITY
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SAN DIEGO



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Naval Ship Systems Command, Washington, D. C.

U. S. Coast Guard, Washington, D. C.

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FINAL REPORT

VISIBILITY LABORATORY San Diego, California 92152

UNIVERSITY OF CALIFORNIA, SAN DIEGO
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VISIBILITY LABORATORY
SAN DIEGO, CALIFORNIA 92152

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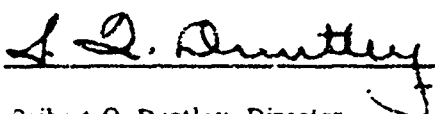
October 1968

FINAL REPORT

Naval Ship Systems Command
Department of the Navy
Washington, D. C. 01731

U. S. Coast Guard
1300 E Street, N.W.
Washington, D. C. 20226

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EMPIRICAL SWEEP WIDTH ANALYSIS

(AIR TO SURFACE)

William Hadley Richardson

ABSTRACT

This study considered 3861 reports of air to sea surface sightings, converted with range and bearing data into lateral range distributions classified by vessel size and altitude, on subclasses of meteorological visibility, wind velocity, swell height, and cloud cover. From these lateral range distributions were developed a revised sweep width table and white can and cloud cover correction tables for boats and ships.

INTRODUCTION

The purpose of this project is to confirm or correct the sweep width table currently being used in the air search for sea surface targets by the U. S. Coast Guard and various military services and civilian agencies. The current sweep width table is published in the National Search and Rescue Manual (1) and is reproduced as Appendix A.

The basis of the study is the data accumulated in the program directed by Operations Instruction 58-55, U. S. Coast Guard, 8 September 1955 (Appendix B).

The project was planned for two phases:

The first phase was to include the determination of lateral range distributions, exploration of the possibility of determining sweep widths empirically and the desirability of continuing the study.

The second phase, dependent on the results of the first phase, would be the finalizing of the work by producing new sweep width tables or other means of readily forecasting sweep widths from given search conditions.

This report completes the first phase. Since, in carrying out the planned mission of the first phase, sweep width tables were developed, this constitutes the final report on the project.

THE DATA

The source of the data is the collection of 12,127 completed sighting Data Reports, Form CG-3627 (Appendix C). In addition to date and designation of submitting unit these forms reported target type, sighting range and method of determining, relative bearing in clock code, wake size, visual aid if any, time of day (day, night, twilight), altitude of aircraft or height of eye on vessel, surface wind velocity and true direction, height of major swells, percent cloud cover, meteorological visibility, position of sun, observer sighting, type of observing unit.

The information on each form was abstracted on an electronic data processing (EDP) card in numerical code (Appendix D). To facilitate computer work the cards were recorded on magnetic tape.

The conglomerate of all sightings was then poured through a logical sieve (Appendix E), based on type of unit, observer, altitude of aircraft and height of eye, to determine definite air-surface, definite surface-surface and doubtful sightings. The definite air-surface and surface-surface sightings were recorded on separate tapes. There are a total of 3861 definite air-surface sightings.

THE METHOD

The first task is to calculate the lateral range distribution under specific conditions. The lateral range is the projection of the sighting range of a target on the perpendicular to the path of the sighting vehicle (Figure 1).

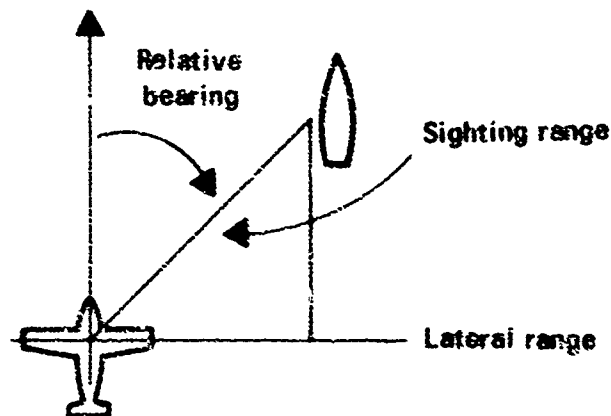


Figure 1

In the data for this study, relative bearing is given in clock code. That is: 0 = 0°; 1 = 30°; etc.. To achieve a lateral range distribution in miles the number of sightings at a given clock code and sighting range must be spread over the interval 15° to each side of the clock code. As an approximation the sightings are evenly distributed over the projection of the interval on the perpendicular to the vehicle's path and all sightings are folded into one quadrant, clock zero to clock three, (Figure 2).

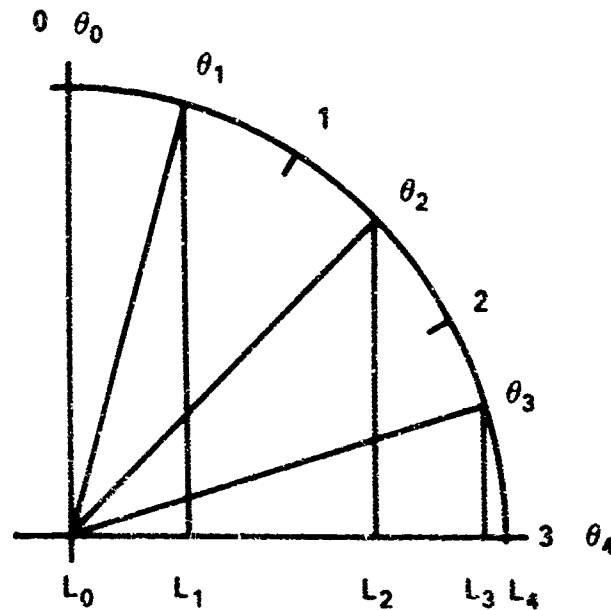


Figure 2

The lateral range distribution of each range-clock class then is:

$$f_{Ri}(L_j) = \frac{N_{Ri}}{L_{i+1} - L_i} ; j : L_i \leq L_j < L_{i+1}, i = (0, 3).$$

and R is sighting range,

L is lateral range in miles,

$$L_i = R \sin \theta_i.$$

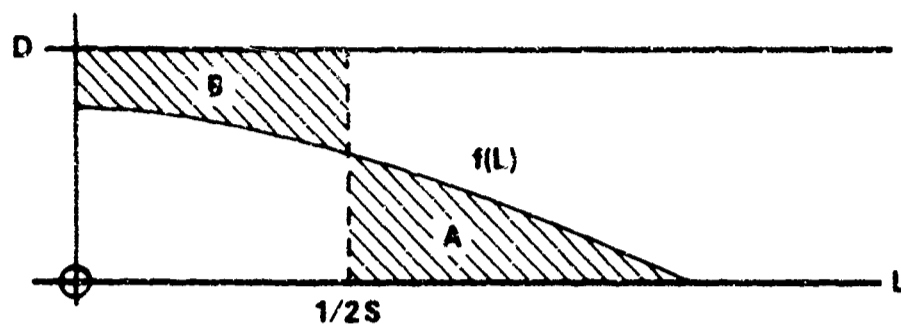
N_{Ri} is number of sightings at (R, C_i) ; C is clock code.

Fractional miles at the extremities of the $L_{i+1} - L_i$ interval are accounted for by interpolation. The complete lateral range distribution is:

$$f(L_j) = \sum_R \sum_i f_{Ri}(L_j).$$

Fractional miles at the extremities of the $L_{i+1} - L_i$ interval are accounted for by interpolation.

Having the lateral range distribution the next step is to determine the sweep width. The sweep width is defined as the width of a band, lying on the surface, centered axially along the course, such that the number of targets sighted outside the band are equal to the number missed within the band. The National Search and Rescue Manual defines the sweep width "...scattered targets which may be detected beyond these arbitrary limits are equal in number to those which may be missed within these limits". (Figure 3).



- Area A = targets detected
 Area B = targets missed
 S = sweep width
 $f(L)$ = lateral range distribution,
 folded at $L = 0$.
 D = density of available targets
 per unit lateral range.

Figure 3

This may be expressed analytically:

$$\int_0^{1/2S} [D - f(L)] dL = \int_{1/2S}^{\infty} f(L) dL$$

where D is target density per unit L. This reduces to

$$S = \frac{2 \int_0^{\infty} f(L) dL}{D} \quad (1)$$

This formula corresponds to Koopman's (2) formula (27), par. 2.4, p.24 which defines sweep width:

$$W = \int_{-\infty}^{\infty} p(x) dx, \quad (2)$$

where W is sweep width, $p(x)$ is probability of detection at lateral range x. The term $p(x)$ in equation (2) is equivalent to $f(L)/D$ in equation (1) and the distribution is considered symmetrical in equation (1).

Equation (1) is converted for use in discrete calculations to:

$$S = \frac{2 \sum_{i=0}^{\infty} f(L_i) \Delta L}{D}$$

in this study $\Delta L = 1$.

One of the objectives of this project was to find if D could be determined statistically or by deduction or inference. Intensive investigation of the distribution functions, their character and variation, has resulted in no success in defining D . The reports only report sightings but do not give any information on targets available to sight. It seems reasonable to assume that the density, D , per unit lateral range, L , in a distribution is not less than the maximum frequency per unit lateral range found in the distribution. Taking D as the maximum frequency gives the formula:

$$S_{max} = \frac{2 \sum_{i=0}^{\infty} f(L_i)}{f(L_i)_{max}}$$

S is a maximum here since if D were any greater than $f(L_i)_{max}$ S would be less. Hence S_{max} is an upper bound on the sweep width.

THE CALCULATIONS

Before starting the calculations a choice had to be made of the variable conditions which would affect significantly the sweep width. Richardson (3) determined the conditions in order of statistical significance with respect to sighting range to be visibility, altitude, vessel size, swell height, cloud cover, wind velocity. The other variables, while of statistical significance, except for wind azimuth, are not considered to be of practical significance.

The decision was to make a study of daytime sightings of each class of vessel with sweep width as the dependent variable and altitude and one of the following as independent variables in each phase of the vessel study: visibility, swell height, cloud cover, wind velocity. Special targets such as life rafts or mirrors were not included because of small numbers of sightings. Vessels are classed as in the sweep width table for small boats and as in the sighting reports for large vessels, altitude is classed in 1000 foot intervals from zero to 3000 feet. Smaller intervals and classes over 3000 feet would give too small a class population for effective analysis. Visibility is classed in five mile intervals from zero to 30 miles. Swell height is classed in two foot intervals from zero to ten feet. Cloud cover is classed in 20 percent intervals from zero to 100. Wind velocity is classed in five knot intervals from zero to 40. Higher classes in these parameters are precluded by sparse populations. There is no discrimination between light and dark boats since analysis showed the difference to be negligible. Summarizing:

Parameter	Range	Increment
Altitude	0 - 3000 ft.	1000 ft.
Visibility	0 - 30 mi.	5 mi.
Swell height	0 - 10 ft.	2 ft.
Cloud cover	0 - 100%	20%
Wind velocity	0 - 40 knots	5 knots

A computer program was written then which would convert the data to digestible form. The final objective was to obtain a family of sweep widths which could be analyzed to find how the sweep widths vary with respect to each of the several parameters. In the process of doing this much information would be developed which would be of subsidiary interest and the program was designed to produce this information. The program was written in FORTRAN 63 for the CDC 3600 computer at the Computer Center, University of California, San Diego. The construction of this program constituted the major part of the work involved in this project, since, as the program developed and was tested, opportunities appeared for improvement, addition, revision and refinement. The result is a fairly generalized and adaptable program that produces a large amount of information that may well be of use in further studies and the program can be used for different applications such as surface-to-surface sightings, and for different choices of parameter classes or even for different parameters with appropriate changes.

THE RESULTS

The program as run treats each vessel class in turn and cycles through each of the four parameters turning out a graph of lateral range distribution for each altitude class, a table of the sets of data shown, in the graphs, a graph and table of sums of sightings in each altitude class, a graph and table of sums of sightings at each lateral range, a graph and table of sweep widths at each altitude class and the sweep width for the parameter class including all altitudes. When all classes of the parameter have been cycled through, the program prints a parameter summary for the vessel class. This consists of a graph of lateral range distribution for each altitude class including all classes of the parameter and a table of these data, a graph and table of the lateral range distribution including all altitudes, a graph of sweep widths for each parameter class, a graph of sweep widths at each altitude class including all parameter classes and two tables: one of sweep width by altitude and parameter classes; one of number of sightings by altitude and parameter classes. These last two tables are included in Appendix F. On completion of all parameters there is a vessel summary with a graph of lateral range distributions by altitude for the vessel and a table of this data, a graph of the overall lateral range distribution and summary tables of sweep widths and number of sightings by parameter and altitude. These last summaries are included in Appendix F and is the basis for the analysis. Finally a scan through the tape is made sorting out those sightings of vessels concerned for which sighting range, clock code and altitude are reported and there is a graph of the lateral range distribution for each altitude with a table of the data, a graph of lateral range distribution for all vessels with a table and summary tables of sweep width by altitude and vessel. This problem summary is defective in this particular problem since there was a fatal machine error after 74 minutes which lost the early information for the summary. This was not retrieved since it seemed to be of only incidental interest in this application. The productive running time for the problem was 100 minutes.

In addition to the print-out above, the program produced EDP decks of the summaries in Appendix F, and of all lateral range distributions. These can be used in further studies.

THE ANALYSIS

It then appeared that some method of smoothing the results of the data reduction process would be necessary. It would be advantageous to construct tables similar to the sweep width tables that observers have been using but with three classes of large vessels instead of grouping them in one class. From the results this seemed to be feasible. The current sweep width table has a subtable for each vessel size giving sweep widths dependent on altitude and meteorological visibility. This would indicate fitting a hypersurface in four dimensions with sweep width, the dependent variable, and ship length, visibility, altitude, the independent variables, using a least squares approximation with a suitable regression function. To investigate possible functions six sets of graphs were made (Appendix G). In all graphs the dependent variable, the ordinate, is sweep width (W). The graphs were constructed as follows:

Set number	Fixed in each Graph	Independent variable	Parameter
1	Ship size (X)	Visibility (Y)	Altitude (Z)
2	Ship size (X)	Altitude (Z)	Visibility (Y)
3	Visibility (Y)	Ship size (X)	Altitude (Z)
4	Visibility (Y)	Altitude (Z)	Ship size (X)
5	Altitude (Z)	Ship size (X)	Visibility (Y)
6	Altitude (Z)	Visibility (Y)	Ship size (X)

In set 1, assuming linear regression, in each graph, of the form $W = a + bY$ it is evident that as the ship size increases generally from graph to graph, the slope of the fitted line increases. To account for this the slope, b, must vary with ship size giving a function: $W = a + b(X)Y$. Inspection of set 3 indicates a possible variation of a with ship size, so: $W = a(X) + b(X)Y$. Assuming for simplicity a linear function for a(X) and b(X), the relationship would become: $W(X,Y) = a + bX + cY + dXY$. The coefficients a,b,c and d are arbitrary within each function. Altitude has not been included in the function so far.

Investigation of set 2 in connection with set 5, shows a similar reaction of W to altitude and ship size, giving: $W(X,Z) = a + bX + cZ + dXZ$.

All other sets show a similar reaction of W, so it would appear that a trial approximating fit would be:

$$W = a + bX + cY + dZ + eXY + fXZ + gYZ.$$

Consideration of the graphs also showed that the assumed linear regressions might be too rigid and that a regression on the logarithm of the variable might give better results. Richardson (3) used a logarithmic type regression function for ship size and visibility to attain a high correlation coefficient. The decision was made to program the least squares fitting algorithm using the above function with the possibility of various mixes of linear and logarithmic treatment of the independent variables.

All combinations of linear and logarithmic treatment were run and standard deviations of (W X,Y,Z) calculated. The lowest standard deviation (2.123) was with log X, log Y, linear Z, and this combination also gave the most reasonable appearing fit. This fit was chosen as the best (Appendix H) of the mixes. The most significant differences of calculated and SAR values show up in high altitudes with high visibility where calculated values are appreciably less than SAR values. Other than this there is surprising agreement between the two tables.

It is now possible to construct a revision of the SAR table. It is considered that this is a conservative problem, that is, that it is desirable to err on the side of higher probability of sighting than otherwise, or, in other words, on the side of smaller sweep width. Applying this criterion to the construction of a revised table means simply choosing for each cell of the new table the lesser value from the calculated table or the SAR table. When a fitted value is negative it is taken to be zero. Having done this there remains an evident anomaly in that, as a result of remaining rigidity in the fit, there are a few cases where, under given conditions the sweep widths for smaller vessels are larger than for larger vessels. This is not reasonable and the sweep widths in these cases are limited to the sweep widths of the largest vessel. The resulting table is shown in Appendix I. This table meets the criterion of minimizing the sweep width, but there is one questionable point that is evident on inspection of the original SAR table. In the 500 and 1000 foot altitude columns of the SAR table for boats and vessels a number of the values are unreasonably and unexplainably low. There appears no good reason why, as altitude increases, sweep width should drop markedly and then steadily increase. The few places where this appears in Table I have been arbitrarily changed by interpolation to remove this irregularity and the resulting table is in Appendix J. This revised table, a composite of the SAR table and the calculated table, shows a very smooth appearance and appears quite reasonable. It complies with the conservative or minimum criterion with the exception of the removal of last mentioned irregularities.

Referring to the current SAR sweep width tables, there remained the Whitecap Correction Factor Table to complete. Here two classes of vessel were considered, small boats and ships. This table is based on wind velocity. Weighted means of the three classes of boats or ships in each of the wind velocity summary classes were computed and these means normalized with respect to the mean sweep width. As an approximation function to smooth the data a second degree curve was fitted (Appendix K) with the following result:

Wind	Small boats		Ships	
	Calculated	SAR	Calculated	SAR
0	0.9	0.8	1.1	0.9
5	1.0	None	1.1	None
10	1.0	1.0	1.0	1.0
15	1.1	0.9	1.0	1.0
20	1.0	0.7	0.9	0.9
25	0.9	0.5	0.8	0.8
30	0.7	0.3	0.7	0.7
40	0.2	0.2	0.5	0.6
50	-	0.1	0.2	0.4
60	-	-	-	0.2
Standard error of estimate	0.058		0.079	

The swell height analysis from the data reduction run was studied but did not appear to be as effective in developing factors as the wind velocity. The plots of variation of sweep width with respect to swell height appeared visually to be correlated with variation of equivalent wind velocities. While Richardson (3) found swell height more significant statistically than wind velocity in affecting sighting range, that does not seem to apply from the standpoint of practical significance in this study.

The remaining variable in the data reduction operation, cloud cover, was studied and did show an effect on sweep width though not as pronounced as wind velocity. The family of sweep widths was treated by the same method as in wind velocity with the following comparative results (Appendix L).

Percent Cloud Cover	Boats	Ships	All (weighted mean)
0	1.1	1.0	1.1
10	1.1	1.1	1.1
20	1.0	1.1	1.1
30	1.0	1.1	1.0
40	1.0	1.1	1.0
50	0.9	1.1	1.0
60	0.9	1.0	1.0
70	0.9	1.0	0.9
80	0.9	0.9	0.9
90	0.8	0.8	0.8
100	0.8	0.7	0.7
Standard error of estimate	0.074	0.018	

RECOMMENDATIONS

It is recommended that the revised table in Appendix J, Suggested Sweep Width Table II (Revised), be adopted along with the new white cap and cloud cover correction factors

BIBLIOGRAPHY

1. U. S. Coast Guard, **National Search and Rescue Manual**, CG308, Superintendent of Documents, U. S. Government Printing Office, Washington, (1 July 1959), with amendments 1-4.
2. Koopman, B. O., **Search and Screening**, OEG Report No. 56, J. S. Navy, Washington (1946).
3. Richardson, W. H., **A Study of the Factors Affecting the Sighting of Surface Vessels from Aircraft**, SIO Ref. 62-13, Visibility Laboratory, Scripps Institution of Oceanography, University of California, San Diego (1962).

SWEEP WIDTH W FOR VISUAL SEARCH
Values for W given in Nautical Miles

Observer's Altitude in Feet	Life Rafts					Small Boats (Less 30')					Small Boats (30' to 60')					Small Boats (60' to 90')					Large Vessels				
	Dist- Range	5	10	20	30	Dist- Range	5	10	20	30	Dist- Range	5	10	20	30	Dist- Range	5	10	20	30	Dist- Range	5	10	20	30
	1	.7	.7	.8	.8	.7	.7	.7	.8	.8	.7	.6	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9	.9
3	1.0	1.2	1.8	1.8	2.5	2.0	2.0	2.3	2.9	3.0	3.5	2.6	6.9	3.1	3.2	3.9	3.2	3.3	3.3	3.3	3.4	1.0	1.5	1.5	1.5
5	1.4	1.6	1.6	2.7	2.7	2.2	2.2	2.7	3.2	4.0	4.2	3.0	3.6	4.2	4.3	5.0	4.2	6.5	4.7	4.7	4.7	8.0	7.0	7.3	7.4
10	1.8	1.8	2.1	3.6	3.9	3.5	3.5	4.2	4.5	5.8	6.5	5.5	5.8	6.2	6.5	8.0	7.1	7.3	8.0	8.3	8.3	10.0	10.2	11.0	11.3
15	1.9	1.9	2.6	3.6	3.2	4.8	5.5	6.7	7.0	8.5	7.6	7.6	7.4	8.6	9.8	11.0	10.0	12.0	13.0	13.0	13.0	14.0	13.0	15.0	16.2
20	2.0	2.1	2.8	3.6	3.3	5.1	6.2	6.8	7.1	8.6	8.2	8.2	9.0	9.6	10.0	12.0	12.0	12.5	13.0	13.0	13.5	15.0	15.0	16.0	17.5
30	2.1	2.3	3.9	3.6	3.5	3.9	7.0	7.0	7.1	7.2	8.7	9.5	11.0	11.0	12.0	12.5	12.5	13.0	13.5	13.5	14.0	17.0	17.0	18.0	18.5
40	2.2	2.4	2.9	3.6	3.6	6.0	7.1	7.1	7.1	7.2	8.9	10.0	11.0	12.0	12.5	13.0	13.0	14.0	14.5	15.0	15.0	17.0	18.0	19.0	19.0
50	2.2	2.4	3.0	3.6	3.6	5.7	6.0	7.2	7.2	7.3	9.0	10.0	12.0	12.5	13.0	13.5	13.5	14.5	15.0	15.0	15.5	20.0	21.0	21.0	21.5

Figure 7-2

WINDCAP CORRECTION FACTORS

WIND (KNOTS)	0	10	15	20	25	30	40	50	60
RAFTS	.8	1.0	.9	.7	.5	.2	.1	—	—
SMALL BOATS	.8	1.0	.9	.7	.5	.3	.2	.1	—
SHIPS	.9	1.0	1.0	.9	.8	.7	.6	.4	.2
FTS WARPEN	.9	1.0	1.0	.9	.6	.4	.2	—	—
SHO/SE	.8	1.0	.8	.6	.4	.2	.1	—	—

Figure 7-2a

VALUES FOR V FOR VISUAL AIDS (Based on 30 miles visibility)

Daytime:
Dye Marker - 4 miles (reducing to nil in heavy seas)
Mirror - 8 miles
Orange Smoke - 12 miles (greatly reduced in high winds)
White Smoke - 16 miles (greatly reduced in high winds)

Nighttime:
Very Light - 24 miles
Faint Light - 20 miles
Mk. 13 Flare - 22 miles

Figure 7-2b

C O P Y

UNITED STATES COAST GUARD

ADDRESSES ONLY TO:
COMMANDANT
U.S. COAST GUARD
HEADQUARTERS
WASHINGTON 25, D.C.



O
8 September 1955

OPERATIONS INSTRUCTION NO. 58-55

Subj: Sighting Data Report (Form CG-3627); instructions for

1. Purpose. To prescribe procedures which are required of aircraft and certain floating units relative to the preparation and submission of data collected in connection with the program for the collection of sighting data.
2. Objective. This program is designed to collect reports of 8-10,000 sightings of life rafts, emergency visual signals, small boats and vessels under many visibility and air and sea conditions.
3. Information. Presently available "Effective Visibility" tables do not include small boats and vessels with which the Coast Guard is commonly concerned, nor is the condition of air and sea taken into consideration. Therefore, in order to obtain more realistic tables on this important subject, the U. S. Navy, at the request of the Coast Guard, has agreed to evaluate (by use of Univac machines) sighting data collected by the Coast Guard and to derive empirical formulae from which curves for search, sweep width, and sighting effectiveness may be drawn. These results will ultimately be incorporated in a Coast Guard Search and Rescue Manual.
4. Action.
 - a. Floating units 83' in length and over and aircraft shall fill in subject form, which is self explanatory, on each sighting deemed to be advantageous to the program. Data must be complete for each sighting reported. Forms should be carried on all flights over water and on bridges of floating units ready for use as may be practicable.
 - b. Units shall submit forms to Commandant (O) in lots of 100 sighting reports.
5. Availability of Forms. An initial distribution of Form CG-3627 will be made in the near future to all aviation units and floating units 83' in length and over. The form will be included in the Catalog of Forms (CG 218) with source of supply "SC".

APPENDIX B (Cont.)

C O P Y

OPERATIONS INSTRUCTION W. 58-55

6. Effective date. This instruction is effective upon receipt and will be canceled by separate instruction upon completion of the project.

H. C. PERKINS
By direction

Encl: (1) Sighting Data Report,
Form CG-3627

Dist. (SDL No. 61)
A: a,aahcd(5); efi(3); g.1.2.3. h,jklmn(1)
B: C(15); eghi(5); jl(3); d(2); b(1)
C: A(5); bd(3)
D: NONE

TREASURY DEPARTMENT U. S. COAST GUARD CG-3627 (8-55)		SIGHTING DATA REPORT		1. DATE SIGHTED (Day, month, year)
TO: Commandant (O)				
FROM (Forwarding letter not necessary):				
2. TARGET TYPE (Check and complete)				
101 ONE MAN LIFE RAFT	106 MK-13 NIGHT SIGNAL	11 TYPE 11 SMALL BOAT 1'	12 MEDIUM VESSEL (1500 to 10000 tons)	
102 SEVEN MAN LIFE RAFT	107 VERY'S PISTOL SIGNAL	12 TYPE 12 SMALL BOAT 1'	13 LARGE VESSEL (Over 10000 tons)	
103 TWENTY MAN LIFE RAFT	108 SIGNALING MIRROR	13 TYPE 13 SMALL BOAT 1'	14 OTHER (Describe)	
104 ORANGE SMOKE SIGNAL	109 TYPE 1 SMALL BOAT 1'	14 TYPE 1 SMALL BOAT 1'		
105 SEA DYE-MARKER	110 TYPE 11 SMALL BOAT 1'	15 SMALL VESSEL (500 to 5000 tons)		
3. SIGHTING RANGE (Naut. miles & tenshs)				
WIND (Check)	RANGE			
ESTIMATED				
RAIDER				
TIME-DISTANCE CHECK				
4. CLOCK CODE (Relative bearing, 0-12 hours)				
5. WAKE SIZE (Check)				
0 NEGLIGIBLE				
1 ONE-HALF LENGTH OF OBJECT				
2 ONE LENGTH OF OBJECT				
3 TWICE LENGTH OF OBJECT				
4 OVER TWICE THE LENGTH				
6. VISUAL AID (Check and complete)				
1 NONE				
2 BINOCULARS				
3 SUN GLASSES				
4 OTHER (Describe)				
7. TIME OF DAY (Check)				
N NIGHT				
D DAY				
T TWILIGHT (Morning or evening)				
7A. ALTITUDE (700 ft. or less)				
7B. HEIGHT OF EYE IN FEET				
7C. HEIGHT OF SIGHTING FROM VESSEL (For sighting from vessel)				
8. CLOUD COVER (%)				
9. SURFACE WIND FROM (Degrees true)				
10. HEIGHT OF MAJOR SWELLS (Feet)				
11. CLOUD COVER (%)				
12. METEOROLOGICAL VISIBILITY (Miles)				
13. POSITION OF SUN				
RELATIVE BEARING FROM LINE OF SIGHT (Degrees)				
14. OBSERVER (Check and complete)				
A. AIRCRAFT				
1 PILOT	B. VESSEL			
2 CO-PILOT	11 CO			
3 NOW LOOKOUT	12 GOD			
4 WAIST LOOKOUT	13 OM			
5 TAIL LOOKOUT	14 BRIDGE LOOKOUT			
6 OTHER (Specify)	15 DECK LOOKOUT			
16 OTHER (Specify)				
15. TYPE OF OBSERVING UNIT (Check and complete)				
1 PATROL PLANE (Including H.P.s)				
2 UTILITY PLANE				
3 HELICOPTER				
4 VESSEL OVER 200 FEET				
5 VESSEL 150-200 FEET				
6 VESSEL UNDER 150 FEET				
7 OTHER (Describe)				
1/ Types of boats are as follows:				
TYPE	LENGTH	DESCRIPTION		
I	Less than 30 Feet	Bright colors such as white, orange, yellow, red. Little or no superstructure.		
II	Less than 30 Feet	Dark colors such as black, blue, green, grey, offering little or no contrast with water.		
III	30 to 40 Feet	Bright colors such as white, orange, yellow, red.		
IV	30 to 40 Feet	Dark colors such as black, blue, green, grey.		
V	60 to 100 Feet	Bright colors such as white, orange, yellow, red.		
VI	60 to 100 Feet	Dark colors such as black, blue, green, grey.		
2/ Meteorological visibility should be estimated by determining range at which land masses, ships, or other targets can be seen.				
NOTES: This form should be filled out using heavy, dark-colored pencil or pen and ink. Prepare original only. USE REVERSE FOR REMARKS.				

GPO 887355

APPENDIX D

IBM

INTERNATIONAL BUSINESS MACHINES CORPORATION

Form X24-6299-1
Printed in U. S. A.

CARD PUNCHING OR VERIFYING INSTRUCTIONS

JOB NAME USCG Sighting Reports		JOB NO		CONTROL PANEL NO.		OPERATION NAME		OP CODE		MACH TYPE	
FREQUENCY <input type="checkbox"/> Daily <input type="checkbox"/> Monthly <input type="checkbox"/> Weekly <input type="checkbox"/> Quarterly <input type="checkbox"/> Bi-Weekly <input type="checkbox"/> Annual <input type="checkbox"/> Semi-Monthly <input type="checkbox"/> Other		DUE IN TIME DATE		DUE OUT TIME DATE		ESTIMATED VOLUME		EST TIME HOURS TENTHS			
PROGRAM CARD NO						CARD ELECTRO (FORM) NO					
SWITCH SETTINGS						SPECIAL FEATURES USED					
ON OFF		SWITCH				<input type="checkbox"/> ALTERNATE PROGRAM <input type="checkbox"/> HI SPEED SKIP					
		PROGRAM UNIT				<input type="checkbox"/> AUXILIARY DUPLICATE <input type="checkbox"/> INTERSPERSED GANG PUNCH					
		AUTO FEED				<input type="checkbox"/> CARD REVERSING <input type="checkbox"/> CONTINUOUS SKIP					
		AUTO SKIP—AUTO DUPL				<input type="checkbox"/> CARD INSERTION <input type="checkbox"/> CONTINUOUS SPACE					
<input checked="" type="checkbox"/>		PRINT				<input type="checkbox"/> DECIMAL TABULATION <input type="checkbox"/> SELF CHECKING NO					
		SELF CHECKING NO									
SOURCE DOCUMENTS USED: USCG Sighting Data Report						DISPOSITION OF CARDS: VisLab					
RECEIVED FROM: VisLab, U of C, S.D. 92152						DOCUMENTS VisLab					
CARD FIELD		COLUMNS FROM TO		FUNCTION*		REMARKS					
1. Date sighted (1) day		1 2									
2. month		3 4									
3. year		5				Last digit of year. If missing leave blank					
4. Source of report		6 8				Box labeled "FROM"					
5. Target type (2)		9 10									
6. Sighting range (3), range		11 13				Miles and tenths. No decimal point					
7. method		14 15				1, estimated; 2, radar 3, TD Check.					
8. Clock code (4)		16 17									
9. Wake size (5)		18 19									
10. Visual aid (6)		20 21									
11. Time of day (7)		22 23									
12. Altitude of aircraft (8)		24 25				100's of feet					
13. Height of eye in feet (8a)		26 27				Feet					
14. Surface wind (9) knots		28 29				Cal		FUNCTION* code 00 DUPLICATE PUNCH X-SKIP VERIFY SELF NO CK		SYMBOL D P S -2 XS V CK	
15. from		30 32				Cal					
TOTAL KEY STROKES PER CARD—											

630610MSP

Date _____

Section _____ Page _____

[illegible]

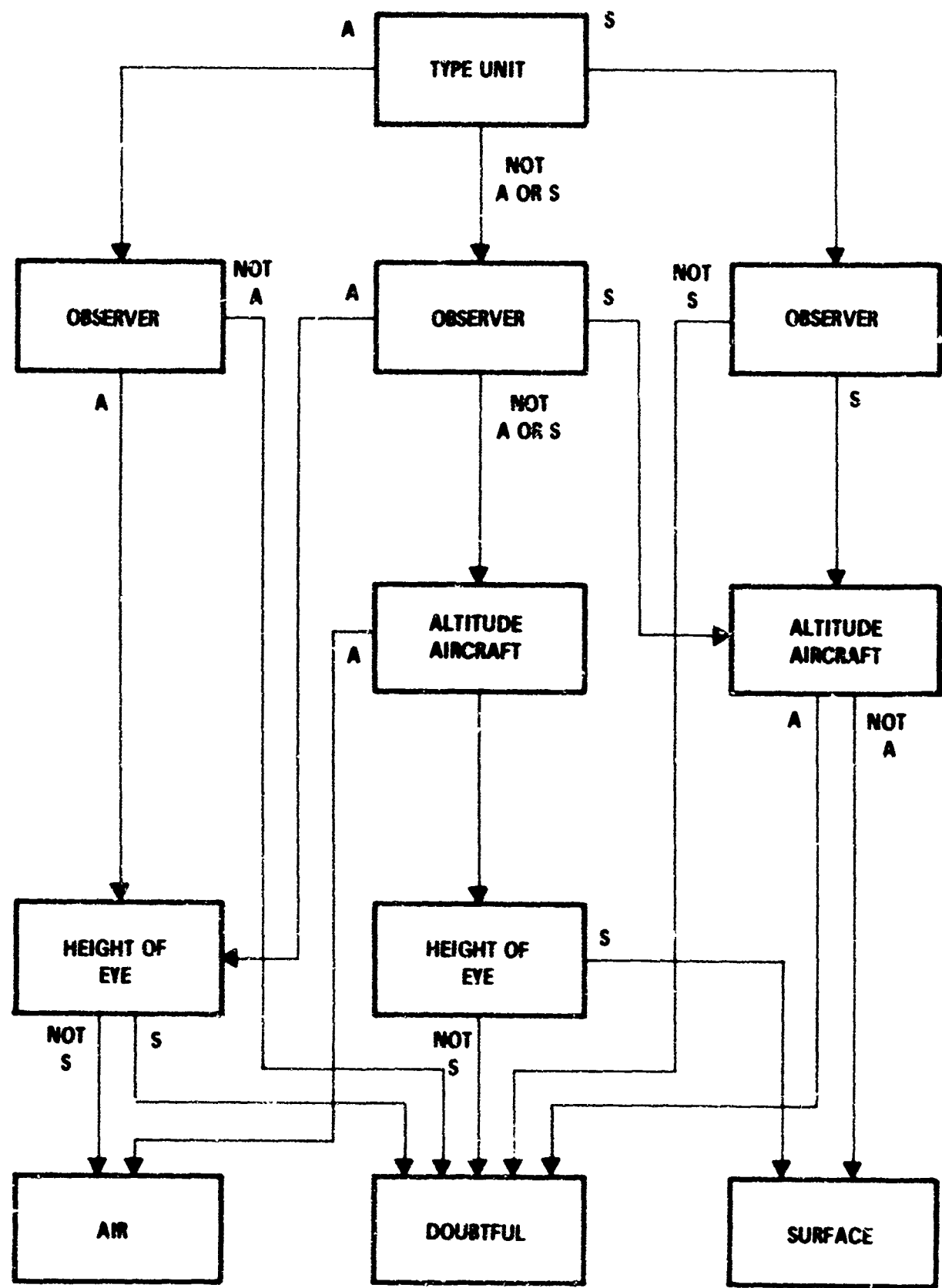
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Printed in U S A.

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Page _____

APPENDIX E

LOGICAL SIEVE FOR AIR, SURFACE, DOUBTFUL SIGHTINGS



APPENDIX F

SWEEP WIDTH SUMMARY TABLE FOR VISIBILITY

TARGETS...TYPE 1 SMALL BOAT TYPE 2 SMALL BOAT

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000, (3) 3000 TO 4000, (4) 4000 TO 5000, (5) 5000 TO 6000, (6) 6000 TO 7000, (7) 7000 TO 8000, (8) 8000 TO 9000, (9) 9000 TO 10000.

THE PARAMETER (VISIBILITY IN MILES) IS CLASSED AS FOLLOWS ... (0) 0 TO 5, (1) 5 TO 10, (2) 10 TO 15, (3) 15 TO 20, (4) 20 TO 25, (5) 25 TO 30, (6) 30 TO 35, (7) 35 TO 40, (8) 40 TO 45, (9) 45 TO 50.

ALTITUDE CLASS	0	1	2	3	4	5	ALL
0	2.808E 00	5.749E 00	4.130E 00	7.943E 00	5.492E 00	4.764E 00	4.872E 00
1	4.000E 00	3.765E 00	5.764E 00	6.561E 00	9.044E 00	5.548E 00	6.433E 00
2	0	4.820E 00	4.569E 00	7.415E 00	6.221E 00	3.783E 00	5.970E 00
ALL	2.867E 00	4.978E 00	4.662E 00	6.971E 00	8.224E 00	5.751E 00	5.680E 00

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	4	5	ALL
0	2.700E 01	4.500E 01	5.800E 01	4.800E 01	2.100E 01	7.300E 00	2.060E 02
1	2.000E 00	2.600E 01	4.100E 01	1.210E 02	5.500E 01	1.500E 01	2.600E 02
2	0	1.100E 01	1.800E 01	2.400E 01	1.700E 01	2.000E 00	7.600E 01
ALL	2.900E 01	8.200E 01	1.170E 02	1.970E 02	9.300E 01	2.400E 01	5.420E 02

PARAMETER SUMMARY...

TIME = 9.538 SECONDS.

SWEEP WIDTH SUMMARY TABLE FOR VISIBILITY

TARGETS...TYPE 3 SMALL BOAT TYPE 4 SMALL BOAT

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000, (3) 3000 TO 4000, (4) 4000 TO 5000, (5) 5000 TO 6000, (6) 6000 TO 7000, (7) 7000 TO 8000, (8) 8000 TO 9000, (9) 9000 TO 10000.

THE PARAMETER (VISIBILITY IN MILES) IS CLASSED AS FOLLOWS ... (0) 0 TO 5, (1) 5 TO 10, (2) 10 TO 15, (3) 15 TO 20, (4) 20 TO 25, (5) 25 TO 30, (6) 30 TO 35, (7) 35 TO 40, (8) 40 TO 45, (9) 45 TO 50.

ALTITUDE CLASS	0	1	2	3	4	5	ALL
0	4.779E 00	5.609E 00	4.712E 00	9.042E 00	1.201E 01	9.384E 00	7.882E 00
1	3.444E 00	5.564E 00	9.231E 00	1.134E 01	8.553E 00	6.053E 00	8.461E 00
2	0	7.278E 00	9.520E 00	9.092E 00	1.051E 01	1.331E 01	1.135E 01
ALL	4.427E 00	5.757E 00	9.250E 00	1.007E 01	1.110E 01	9.739E 00	8.517E 00

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	4	5	ALL
0	3.300E 01	7.200E 01	6.400E 01	1.180E 02	4.700E 01	1.000E 01	3.440E 02
1	9.000E 00	5.000E 01	8.400E 01	1.620E 02	7.000E 01	2.600E 01	4.350E 02
2	0	1.600E 01	2.400E 01	4.400E 01	2.900E 01	1.300E 01	1.220E 02
ALL	4.200E 01	1.380E 02	1.760E 02	3.240E 02	1.420E 02	4.900E 01	8.710E 02

PARAMETER SUMMARY...

TIME = 9.546 SECONDS.

APPENDIX F (Con't.)

SWEEP WIDTH SUMMARY TABLE FOR VISIBILITY

TARGETS...TYPE 5 SMALL BOAT TYPE 6 SMALL BOAT

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000,

THE PARAMETER (VISIBILITY IN MILES) IS CLASSED AS FOLLOWS ... (0) 0 TO 5, (1) 5 TO 10, (2) 10 TO 15, (3) 15 TO 20, (4) 20 TO 25, (5) 25 TO 30, (

ALTITUDE CLASS	0	1	2	3	4	5	ALL
0	3.957E 00	4.379E 00	5.400E 00	9.715E 00	6.992E 00	0	6.544E 00
1	4.000E 00	6.720E 00	1.034E 01	1.186E 01	6.582E 00	6.523E 00	1.141E 01
2	2.000E 00	7.799E 00	9.227E 00	7.007E 00	6.391E 00	8.282E 00	9.611E 00
ALL	3.611E 00	6.293E 00	9.477E 00	1.194E 01	9.201E 00	8.698E 00	8.888E 00

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	4	5	ALL
0	7.000E 00	1.400E 01	1.200E 01	2.400E 01	1.200E 01	0	7.100E 01
1	2.000E 00	1.400E 01	3.100E 01	3.000E 01	1.500E 01	6.000E 00	9.300E 01
2	1.000E 00	5.000E 00	1.700E 01	1.800E 01	7.000E 00	2.000E 00	9.000E 01
ALL	1.000E 01	3.500E 01	6.000E 01	7.200E 01	3.400E 01	8.000E 00	2.190E 02

PARAMETER SUMMARY...

TIME = 7.539 SECONDS.

SWEEP WIDTH SUMMARY TABLE FOR VISIBILITY

TARGETS...SMALL VESSELS

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000,

THE PARAMETER (VISIBILITY IN MILES) IS CLASSED AS FOLLOWS ... (0) 0 TO 5, (1) 5 TO 10, (2) 10 TO 15, (3) 15 TO 20, (4) 20 TO 25, (5) 25 TO 30, (

ALTITUDE CLASS	0	1	2	3	4	5	ALL
0	5.000E 00	5.555E 00	6.667E 00	1.500E 01	1.177E 01	6.698E 00	1.274E 01
1	0	5.246E 00	4.381E 00	1.175E 01	7.785E 00	4.656E 00	1.328E 01
2	0	2.000E 00	5.555E 00	4.259E 00	1.475E 01	9.974E 00	1.032E 01
ALL	5.000E 00	7.332E 00	7.273E 00	1.377E 01	1.436E 01	1.031E 01	1.081E 01

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	4	5	ALL
0	5.000E 00	4.000E 01	1.000E 01	2.300E 01	2.600E 01	3.000E 00	6.500E 01
1	0	1.400E 01	3.500E 01	6.200E 01	3.100E 01	2.000E 00	1.430E 02
2	0	1.000E 00	1.200E 01	1.500E 01	1.200E 01	5.000E 00	4.500E 01
ALL	5.000E 00	2.400E 01	5.700E 01	9.700E 01	6.900E 01	1.400E 01	2.600E 02

PARAMETER SUMMARY...

TIME = 9.512 SECONDS.

APPENDIX F (Cont.)

SWEEP WIDTH SUMMARY TABLE FOR VISIBILITY

TARGETS...MEDIUM VESSELS

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000,

THE PARAMETER (VISIBILITY IN MILES) IS CLASSED AS FOLLOWS ... (0) 0 TO 5, (1) 5 TO 10, (2) 10 TO 15, (3) 15 TO 20, (4) 20 TO 25, (5) 25 TO 30, (

ALTITUDE CLASS	PARAMETER CLASS						
	0	1	2	3	4	5	ALL
0	2.885E 00	9.916E 00	1.372E 01	1.922E 01	1.992E 01	1.242E 01	1.409E 01
1	3.120E 00	9.060E 00	9.619E 00	1.531E 01	1.600E 01	1.341E 01	1.427E 01
2	3.901E 00	5.084E 00	7.695E 00	1.214E 01	1.173E 01	9.778E 00	1.101E 01
ALL	3.712E 00	9.348E 00	1.001E 01	1.671E 01	1.860E 01	1.744E 01	1.499E 01

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	PARAMETER CLASS						
	0	1	2	3	4	5	ALL
0	4.000E 00	2.000E 01	1.000E 01	1.800E 01	2.200E 01	4.000E 00	7.800E 01
1	1.000E 00	1.800E 01	3.700E 01	6.200E 01	3.400E 01	8.000E 00	1.600E 02
2	3.000E 00	6.000E 00	1.400E 01	1.900E 01	7.000E 00	6.000E 00	5.500E 01
ALL	8.000E 00	4.400E 01	6.100E 01	9.900E 01	6.300E 01	1.800E 01	2.930E 02

PARAMETER SUMMARY...

TIME = 9.435 SECONDS.

SWEEP WIDTH SUMMARY TABLE FOR VISIBILITY

TARGETS...LARGE VESSELS

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000,

THE PARAMETER (VISIBILITY IN MILES) IS CLASSED AS FOLLOWS ... (0) 0 TO 5, (1) 5 TO 10, (2) 10 TO 15, (3) 15 TO 20, (4) 20 TO 25, (5) 25 TO 30, (

ALTITUDE CLASS	PARAMETER CLASS						
	0	1	2	3	4	5	ALL
0	3.329E 00	5.692E 00	9.073E 00	1.674E 01	2.245E 01	1.191E 01	1.537E 01
1	5.504E 00	6.274E 00	1.056E 01	1.383E 01	2.230E 01	1.564E 01	1.447E 01
2	2.000E 00	2.586E 00	8.839E 00	1.141E 01	1.617E 01	7.536E 00	1.344E 01
ALL	5.500E 00	9.844E 00	1.277E 01	1.836E 01	2.427E 01	2.132E 01	1.584E 01

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	PARAMETER CLASS						
	0	1	2	3	4	5	ALL
0	1.000E 00	1.100E 01	7.000E 00	1.400E 01	1.100E 01	3.000E 00	4.900E 01
1	3.000E 00	1.100E 01	2.400E 01	2.000E 01	1.400E 01	5.000E 00	7.700E 01
2	1.000E 00	1.000E 00	7.000E 00	1.100E 01	8.000E 00	4.000E 00	3.200E 01
ALL	7.000E 00	2.300E 01	3.800E 01	4.500E 01	3.300E 01	1.200E 01	1.980E 02

PARAMETER SUMMARY...

TIME = 9.419 SECONDS.

APPENDIX F (Con't.)

SWEEP WIDTH SUMMARY TABLE FOR SWELL HEIGHT

TARGETS...TYPE 5 SMALL BOAT TYPE 6 SMALL BOAT

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 1000,

THE PARAMETER (SWELL HEIGHT IN FEET) IS CLASSED AS FOLLOWS ... (0) 0 TO 2, (1) 2 TO 4, (2) 4 TO 6, (3) 6 TO 8, (4) 8 TO 10, (

ALTITUDE CLASS	0	1	2	3	4	ALL
0	5.879E 00	5.894E 00	4.643E 00	3.400E 00	4.000E 00	6.726E 00
1	9.015E 00	1.040E 01	1.184E 01	1.104E 01	3.845E 00	1.080E 01
2	9.742E 00	1.321E 01	1.742E 01	2.852E 00	0	9.689E 00
ALL	4.607E 00	6.237E 00	9.474E 00	7.818E 00	6.421E 00	8.539E 00

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	4	ALL
0	1.100E 01	3.800E 01	1.300E 01	3.000E 00	2.000E 00	6.700E 01
1	3.300E 01	3.600E 01	2.600E 01	6.000E 00	2.000E 00	1.030E 02
2	3.100E 01	1.600E 01	4.000E 00	3.000E 00	0	5.400E 01
ALL	7.500E 01	9.000E 01	4.300E 01	3.700E 01	4.000E 00	2.240E 02

PARAMETER SUMMARY...

TIME = 9.544 SECONDS.

SWEEP WIDTH SUMMARY TABLE FOR SWELL HEIGHT

TARGETS...SMALL VESSELS

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 1000,

THE PARAMETER (SWELL HEIGHT IN FEET) IS CLASSED AS FOLLOWS ... (0) 0 TO 2, (1) 2 TO 4, (2) 4 TO 6, (3) 6 TO 8, (4) 8 TO 10, (

ALTITUDE CLASS	0	1	2	3	4	ALL
0	7.705E 00	1.170E 01	1.011E 01	7.300E 00	1.242E 01	1.271E 01
1	1.127E 01	1.260E 01	8.592E 00	9.415E 00	6.925E 00	1.106E 01
2	4.700E 00	8.280E 00	8.184E 00	1.132E 01	0	9.939E 00
ALL	1.014E 01	1.101E 01	1.103E 01	8.913E 00	8.415E 00	1.119E 01

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	4	ALL
0	1.900E 01	1.700E 01	1.100E 01	1.400E 01	2.000E 00	6.300E 01
1	6.700E 01	4.700E 01	2.400E 01	1.300E 01	3.000E 00	1.540E 02
2	1.500E 01	2.100E 01	7.000E 00	3.000E 00	0	4.600E 01
ALL	1.010E 02	8.500E 01	4.200E 01	3.000E 01	5.000E 00	2.630E 02

PARAMETER SUMMARY...

TIME = 9.617 SECONDS.

APPENDIX F (Con't.)

SWEEP WIDTH SUMMARY TABLE FOR CLOUD COVER

TARGETS...TYPE 5 SMALL ROAT TYPE 6 SMALL ROAT

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 4000,

THE PARAMETER (CLOUD COVER IN PERCENT) IS CLASSED AS FOLLOWS ... (0) 0 TO 20, (1) 20 TO 40, (2) 40 TO 60, (3) 60 TO 80, (4) 80 TO 100, (

ALTITUDE CLASS	0	1	2	3	4	ALL
0	7.883E 00	7.864E 00	7.894E 00	7.846E 00	4.698E 00	8.072E 00
1	1.338E 01	7.566E 00	6.715E 00	8.579E 00	7.138E 00	1.256E 01
2	6.971E 00	1.009E 01	4.624E 00	6.000E 00	7.498E 00	9.006E 00
ALL	1.122E 01	1.233E 01	7.405E 00	8.253E 00	8.401E 00	1.025E 01

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	4	ALL
0	2.100E 01	3.000E 00	4.000E 00	5.000E 00	8.000E 00	4.100E 01
1	4.100E 01	1.900E 01	8.000E 00	9.000E 00	9.000E 00	8.600E 01
2	2.500E 01	6.000E 00	5.000E 00	3.000E 00	1.500E 01	5.400E 01
ALL	8.700E 01	2.600E 01	1.700E 01	1.700E 01	3.200E 01	1.810E 02

PARAMETER SUMMARY...

TIME = 7.584 SECONDS.

SWEEP WIDTH SUMMARY TABLE FOR CLOUD COVER

TARGETS...SMALL VESSELS

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 4000,

THE PARAMETER (CLOUD COVER IN PERCENT) IS CLASSED AS FOLLOWS ... (0) 0 TO 20, (1) 20 TO 40, (2) 40 TO 60, (3) 60 TO 80, (4) 80 TO 100, (

ALTITUDE CLASS	0	1	2	3	4	ALL
0	7.630E 00	6.000E 00	1.087E 01	7.544E 00	1.121E 01	1.446E 01
1	1.196E 01	1.010E 01	1.734E 01	1.251E 01	7.430E 00	1.116E 01
2	1.549E 01	5.746E 00	7.379E 00	4.702E 00	6.197E 00	9.973E 00
ALL	1.177E 01	1.138E 01	1.061E 01	1.107E 01	9.511E 00	1.183E 01

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	4	ALL
0	1.500E 01	3.000E 00	3.000E 00	1.500E 01	1.300E 01	4.900E 01
1	5.500E 01	1.500E 01	1.400E 01	1.700E 01	2.200E 01	1.270E 02
2	1.600E 01	8.000E 00	6.000E 00	3.000E 00	1.000E 01	4.300E 01
ALL	8.600E 01	2.600E 01	2.700E 01	3.500E 01	4.500E 01	2.190E 02

PARAMETER SUMMARY...

TIME = 7.616 SECONDS.

APPENDIX F (Con't.)

SWEEP WIDTH SUMMARY TABLE FOR WIND VELOCITY

TARGETS...TYPE 1 SMALL BOAT TYPE 2 SMALL BOAT

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000,

THE PARAMETER (WIND VELOCITY IN KNOTS) IS CLASSED AS FOLLOWS ... (0) 0 TO 5, (1) 5 TO 10, (2) 10 TO 15, (3) 15 TO 20, (4) 20 TO 25, (5) 25 TO 30, (6) 30 TO 35, (7) 35 TO 40, (

ALTITUDE CLASS	0	1	2	3	4	5	6	7	ALL
0	5.071E 00	5.335E 00	4.321E 00	4.210E 00	5.395E 00	4.000E 00	5.000E 00	4.000E 00	4.812E 00
1	5.390E 00	6.952E 00	7.732E 00	5.355E 00	6.476E 00	3.459E 00	4.682E 00	3.076E 00	6.557E 00
2	4.395E 00	5.168E 00	7.334E 00	5.843E 00	6.915E 00	7.717E 00			6.676E 00
ALL	5.150E 00	5.933E 00	6.301E 00	5.233E 00	6.448E 00	7.333E 00	5.053E 00	4.758E 00	5.807E 00

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	4	5	6	7	ALL
0	2.900E 01	7.800E 01	5.400E 01	2.900E 01	1.600E 01	6.000E 00	5.000E 00	2.000E 00	2.190E 02
1	6.800E 01	9.900E 01	7.500E 01	3.000E 01	1.800E 01	4.000E 00	3.000E 00	2.000E 00	2.990E 02
2	1.500E 01	3.900E 01	1.400E 01	1.100E 01	5.000E 00	1.000E 00			8.500E 01
ALL	1.120E 02	2.160E 02	1.430E 02	7.000E 01	3.900E 01	1.100E 01	8.000E 00	4.000E 00	6.300E 02

PARAMETER SUMMARY...

TIME = 9.616 SECONDS.

SWEEP WIDTH SUMMARY TABLE FOR WIND VELOCITY

TARGETS...TYPE 3 SMALL BOAT TYPE 4 SMALL BOAT

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000,

THE PARAMETER (WIND VELOCITY IN KNOTS) IS CLASSED AS FOLLOWS ... (0) 0 TO 5, (1) 5 TO 10, (2) 10 TO 15, (3) 15 TO 20, (4) 20 TO 25, (5) 25 TO 30, (6) 30 TO 35, (7) 35 TO 40, (

ALTITUDE CLASS	0	1	2	3	4	5	6	7	ALL
0	1.133E 01	4.859E 00	7.794E 00	8.345E 00	4.749E 00	2.514E 00	5.145E 00	4.000E 00	7.152E 00
1	6.723E 00	1.170E 01	8.329E 00	7.640E 00	4.912E 00	8.595E 00	4.000E 00	4.141E 00	8.717E 00
2	1.153E 01	3.510E 00	1.137E 01	1.082E 01	5.176E 00	4.253E 00	6.964E 00		1.203E 01
ALL	4.445E 00	7.498E 00	4.877E 00	4.140E 00	6.677E 00	6.137E 00	7.270E 00	4.046E 00	8.717E 00

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	4	5	6	7	ALL
0	4.100E 01	1.530E 02	9.900E 01	4.300E 01	2.400E 01	6.000E 00	3.000E 00	2.000E 00	3.610E 02
1	6.000E 01	1.510E 02	1.090E 02	4.700E 01	4.600E 01	1.800E 01	2.000E 00	1.000E 00	4.540E 02
2	2.700E 01	4.100E 01	3.700E 01	2.700E 01	7.000E 00	6.000E 00	1.000E 00		1.360E 02
ALL	1.480E 02	3.550E 02	2.300E 02	1.120E 02	7.700E 01	3.000E 01	6.000E 00	3.000E 00	9.510E 02

PARAMETER SUMMARY...

TIME = 7.710 SECONDS.

APPENDIX F (Con't.)

SWEEP WIDTH SUMMARY TABLE FOR WIND VELOCITY

TARGETS...TYPE 5 SMALL BOAT TYPE 6 SMALL BOAT
ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000,
(3) 3000 TO 4000
THE PARAMETER (WIND VELOCITY IN KNOTS) IS CLASSED AS FOLLOWS ... (0) 0 TO 5, (1) 5 TO 10, (2) 10 TO 15,
(3) 15 TO 20, (4) 20 TO 25, (5) 25 TO 30, (6) 30 TO 35, (7) 35 TO 40, (8)

ALTITUDE CLASS	PARAMETER CLASS								ALL
	0	1	2	3	4	5	6	7	
0	2.921E 00	6.052E 00	6.923E 00	4.539E 00	5.389E 00	4.401E 00	4.000E 00	5.379E 00	6.706E 00
1	7.851E 00	1.234E 01	1.229E 01	8.519E 00	4.801E 00	3.120E 00	0	4.141E 00	1.779E 01
2	9.156E 00	7.479E 00	8.781E 00	1.014E 01	5.363E 00	0	5.694E 00	0	9.560E 00
ALL	6.986E 00	9.320E 00	9.700E 00	1.071E 01	6.157E 00	5.501E 00	6.000E 00	6.162E 00	8.837E 00

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	PARAMETER CLASS								ALL
	0	1	2	3	4	5	6	7	
0	4.000E 00	2.800E 01	2.600E 01	3.000E 00	8.000E 00	4.000E 00	2.000E 00	1.000E 00	7.600E 01
1	2.000E 01	3.600E 01	2.300E 01	1.200E 01	1.600E 01	1.000E 00	0	1.000E 00	1.090E 02
2	9.000E 00	1.700E 01	1.200E 01	1.300E 01	7.000E 00	0	1.000E 00	0	5.900E 01
ALL	3.300E 01	8.100E 01	6.100E 01	2.800E 01	5.100E 01	5.000E 00	3.000E 00	2.000E 00	2.440E 02

PARAMETER SUMMARY...

TIME = 9.677 SECONDS.

SWEEP WIDTH SUMMARY TABLE FOR WIND VELOCITY

TARGETS...SMALL VESSELS
ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000,
(3) 3000 TO 4000
THE PARAMETER (WIND VELOCITY IN KNOTS) IS CLASSED AS FOLLOWS ... (0) 0 TO 5, (1) 5 TO 10, (2) 10 TO 15,
(3) 15 TO 20, (4) 20 TO 25, (5) 25 TO 30, (6) 30 TO 35, (7) 35 TO 40, (8)

ALTITUDE CLASS	PARAMETER CLASS								ALL
	0	1	2	3	4	5	6	7	
0	7.954E 00	1.796E 01	1.121E 01	8.092E 01	0	6.275E 00	0	0	1.329E 01
1	1.019E 01	1.206E 01	1.556E 01	8.077E 00	9.009E 00	7.060E 00	0	0	1.100E 01
2	6.052E 00	9.244E 00	1.028E 01	9.158E 00	5.176E 00	0	6.729E 00	1.255E 01	1.193E 01
ALL	7.634E 00	1.307E 01	1.546E 01	9.244E 00	7.911E 00	7.000E 00	6.729E 00	1.255E 01	1.165E 01

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	PARAMETER CLASS								ALL
	0	1	2	3	4	5	6	7	
0	9.000E 00	2.900E 01	2.000E 01	1.200E 01	0	1.000E 00	0	0	7.100E 01
1	2.700E 01	5.200E 01	3.900E 01	2.300E 01	1.300E 01	1.600E 01	0	0	1.700E 02
2	4.000E 00	1.800E 01	1.600E 01	9.000E 00	3.000E 00	0	1.000E 00	1.000E 00	5.200E 01
ALL	4.000E 01	9.900E 01	7.500E 01	4.400E 01	1.600E 01	1.700E 01	1.000E 01	1.000E 00	2.930E 02

PARAMETER SUMMARY...

TIME = 9.701 SECONDS.

APPENDIX F (Con't.)

SWEEP WIDTH SUMMARY TABLE FOR WIND VELOCITY

TARGETS...MEDIUM VESSELS

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000,

THE PARAMETER (WIND VELOCITY IN KNOTS) IS CLASSED AS FOLLOWS ... (0) 0 TO 5, (1) 5 TO 10, (2) 10 TO 15, (3) 15 TO 20, (4) 20 TO 25, (5) 25 TO 30, (6) 30 TO 35, (7) 35 TO 40, (

ALTITUDE CLASS	0	1	2	3	4	5	6	7	ALL
0	1.106E 01	1.708E 01	1.166E 01	1.414E 01	9.977E 00	4.141E 00	0	2.000E 00	1.714E 01
1	1.418E 01	9.632E 00	1.177E 01	1.183E 01	1.170E 01	6.100E 00	4.000E 00	0	1.498E 01
2	1.345E 01	9.170E 00	1.381E 01	1.711E 01	8.282E 00	2.618E 01	3.000E 00	0	1.320E 01
ALL	1.470E 01	1.328E 01	1.247E 01	1.446E 01	1.178E 01	8.990E 00	5.000E 00	2.000E 00	1.626E 01

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	4	5	6	7	ALL
0	8.000E 00	3.400E 01	2.300E 01	1.000E 01	7.000E 00	2.000E 00	0	1.000E 00	8.500E 01
1	2.400E 01	4.500E 01	3.900E 01	3.200E 01	2.500E 01	1.100E 01	2.000E 00	0	1.800E 02
2	1.100E 01	2.600E 01	1.500E 01	6.000E 00	1.000E 00	4.000E 00	3.000E 00	0	6.600E 01
ALL	4.500E 01	1.050E 02	7.730E 01	4.800E 01	3.300E 01	1.700E 01	5.000E 00	1.000E 00	3.310E 02

PARAMETER SUMMARY...

TIME = 9.559 SECONDS.

SWEEP WIDTH SUMMARY TABLE FOR WIND VELOCITY

TARGETS...LARGE VESSELS

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000,

THE PARAMETER (WIND VELOCITY IN KNOTS) IS CLASSED AS FOLLOWS ... (0) 0 TO 5, (1) 5 TO 10, (2) 10 TO 15, (3) 15 TO 20, (4) 20 TO 25, (5) 25 TO 30, (6) 30 TO 35, (7) 35 TO 40, (

ALTITUDE CLASS	0	1	2	3	4	5	6	7	ALL
0	1.363E 01	2.010E 01	1.039E 01	6.000E 00	6.821E 00	1.883E 01	0	0	1.741E 01
1	7.283E 00	1.377E 01	1.298E 01	1.329E 01	1.448E 01	7.173E 00	1.139E 01	0	1.541E 01
2	5.665E 00	7.669E 00	1.299E 01	9.816E 00	8.912E 00	0	1.614E 01	0	1.367E 01
ALL	1.150E 01	1.533E 01	1.619E 01	1.593E 01	1.317E 01	1.435E 01	1.708E 01	0	1.683E 01

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	4	5	6	7	ALL
0	1.600E 01	1.900E 01	1.000E 01	3.000E 00	4.000E 00	1.000E 00	0	0	5.300E 01
1	1.000E 01	2.300E 01	2.300E 01	1.300E 01	1.400E 01	1.000E 00	2.000E 00	0	8.800E 01
2	2.000E 00	1.200E 01	1.000E 01	4.000E 00	3.000E 00	0	1.000E 00	0	3.400E 01
ALL	2.800E 01	5.400E 01	4.300E 01	2.200E 01	2.300E 01	2.000E 00	3.000E 00	0	1.750E 02

PARAMETER SUMMARY...

TIME = 9.496 SECONDS.

APPENDIX F (Con't.)

SWEEP WIDTH SUMMARY TABLE FOR ALL PARAMETERS

TARGETS...TYPE 1 SMALL BOAT TYPE 2 SMALL BOAT

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000,

PARAMETERS ARE CLASSED AS FOLLOWS... (0) WIND VELOCITY, (1) SWELL HEIGHT, (2) CLOUD COVER, (3) VISIBILITY,

ALTITUDE CLASS	0	1	2	3	VESSEL ALL
0	4.812E 00	4.860E 00	4.786E 00	4.872E 00	4.817E 00
1	6.557E 00	6.337E 00	7.554E 00	6.433E 00	6.522E 00
2	6.676E 00	7.037E 00	7.771E 00	5.970E 00	6.912E 00
ALL	5.807E 00	5.782E 00	6.428E 00	5.680E 00	5.819E 00

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	VESSEL ALL
0	2.190E 02	1.970E 02	1.390E 02	2.060E 02	2.300E 02
1	2.990E 02	2.720E 02	2.330E 02	2.600E 02	3.150E 02
2	8.900E 01	7.600E 01	7.900E 01	7.600E 01	8.800E 01
ALL	6.030E 02	5.450E 02	4.470E 02	5.420E 02	6.730E 02

NOTE...

NUMBERS IN LAST COLUMN (ALL) ARE NOT BASED ON PARAMETER COLUMNS, BUT ARE BASED ON ALL VALID SIGHTINGS FOR THIS VESSEL.

VESSEL SUMMARY...

TIME = 36.919 SECONDS.

SWEEP WIDTH SUMMARY TABLE FOR ALL PARAMETERS

TARGETS...TYPE 3 SMALL BOAT TYPE 4 SMALL BOAT

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000,

PARAMETERS ARE CLASSED AS FOLLOWS... (0) WIND VELOCITY, (1) SWELL HEIGHT, (2) CLOUD COVER, (3) VISIBILITY,

ALTITUDE CLASS	0	1	2	3	VESSEL ALL
0	7.842E 00	7.489E 00	7.621E 00	7.842E 00	8.152E 00
1	8.767E 00	8.785E 00	9.639E 00	8.461E 00	8.520E 00
2	1.203E 01	1.211E 01	1.243E 01	1.135E 01	1.217E 01
ALL	4.737E 00	4.648E 00	9.214E 00	8.517E 00	8.836E 00

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	VESSEL ALL
0	3.610E 02	3.140E 02	2.280E 02	3.440E 02	3.820E 02
1	4.540E 02	4.100E 02	3.600E 02	4.050E 02	4.870E 02
2	1.360E 02	1.310E 02	1.220E 02	1.220E 02	1.510E 02
ALL	9.510E 02	8.550E 02	7.100E 02	8.710E 02	1.020E 03

NOTE...

NUMBERS IN LAST COLUMN (ALL) ARE NOT BASED ON PARAMETER COLUMNS, BUT ARE BASED ON ALL VALID SIGHTINGS FOR THIS VESSEL.

VESSEL SUMMARY...

TIME = 37.040 SECONDS.

APPENDIX F (Con't.)

SWEEP WIDTH SUMMARY TABLE FOR ALL PARAMETERS

TARGETS...TYPE 5 SMALL BOAT

TYPE 6 SMALL BOAT

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000,

PARAMETERS ARE CLASSED AS FOLLOWS... (0) WIND VELOCITY, (1) SWELL HEIGHT,
(2) CLOUD COVER, (3) VISIBILITY,

ALTITUDE CLASS	0	1	2	3	VESSEL ALL
0	6.706E 00	6.026E 00	8.070E 00	6.544E 00	6.706E 00
1	1.079E 01	1.080E 01	1.256E 01	1.141E 01	1.155E 01
2	9.540E 00	9.689E 00	9.005E 00	9.611E 00	1.013E 01
ALL	8.837E 00	8.539E 00	1.025E 01	8.888E 00	9.266E 00

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	VESSEL ALL
0	7.600E 01	6.700E 01	4.100E 01	7.100E 01	7.600E 01
1	1.090E 02	1.030E 02	8.600E 01	9.400E 01	1.190E 02
2	5.900E 01	5.400E 01	5.400E 01	5.000E 01	6.400E 01
ALL	2.440E 02	2.240E 02	1.810E 02	2.140E 02	2.590E 02

NOTE...

NUMBERS IN LAST COLUMN (ALL) ARE NOT BASED ON PARAMETER COLUMNS, BUT ARE BASED ON ALL VALID SIGHTINGS FOR THIS VESSEL.

VESSEL SUMMARY...

TIME = 36.861 SECONDS.

SWEEP WIDTH SUMMARY TABLE FOR ALL PARAMETERS

TARGETS...SMALL VESSELS

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000,

PARAMETERS ARE CLASSED AS FOLLOWS... (0) WIND VELOCITY, (1) SWELL HEIGHT,
(2) CLOUD COVER, (3) VISIBILITY,

ALTITUDE CLASS	0	1	2	3	VESSEL ALL
0	1.929E 01	1.271E 01	1.446E 01	1.274E 01	1.353E 01
1	1.100E 01	1.106E 01	1.116E 01	1.028E 01	1.065E 01
2	1.193E 01	9.939E 00	9.973E 00	1.032E 01	1.131E 01
ALL	1.165E 01	1.119E 01	1.143E 01	1.091E 01	1.141E 01

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	VESSEL ALL
0	7.100E 01	6.300E 01	4.900E 01	6.000E 01	7.600E 01
1	1.700E 02	1.540E 02	1.270E 02	1.490E 02	1.790E 02
2	5.200E 01	4.600E 01	4.300E 01	4.500E 01	5.400E 01
ALL	2.930E 02	2.630E 02	2.190E 02	2.600E 02	3.130E 02

NOTE...

NUMBERS IN LAST COLUMN (ALL) ARE NOT BASED ON PARAMETER COLUMNS, BUT ARE BASED ON ALL VALID SIGHTINGS FOR THIS VESSEL.

VESSEL SUMMARY...

TIME = 36.825 SECONDS.

APPENDIX F (Con't.)

SWEEP WIDTH SUMMARY TABLE FOR ALL PARAMETERS

TARGETS...MEDIUM VESSELS

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000,

PARAMETERS ARE CLASSED AS FOLLOWS... (0) WIND VELOCITY, (1) SWELL HEIGHT, (2) CLOUD COVER, (3) VISIBILITY,

ALTITUDE CLASS	0	1	2	3	VESSEL ALL
0	1.714E 01	1.660E 01	1.495E 01	1.609E 01	1.699E 01
1	1.498E 01	1.534E 01	1.566E 01	1.427E 01	1.474E 01
2	1.320E 01	1.21CE 01	1.769E 01	1.101E 01	1.370E 01
ALL	1.626E 01	1.670E 01	1.594E 01	1.499E 01	1.607E 01

NUMBER IN SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	VESSEL ALL
0	8.500E 01	8.000E 01	4.100E 01	7.400E 01	8.900E 01
1	1.400E 01	1.660E 02	1.420E 02	1.600E 02	1.730E 02
2	6.600E 01	6.400E 01	5.300E 01	5.500E 01	7.400E 01
ALL	3.310E 02	3.100E 02	2.360E 02	2.930E 02	3.560E 02

NOTE...

NUMBERS IN LAST COLUMN (ALL) ARE NOT BASED ON PARAMETER COLUMNS, BUT ARE BASED ON ALL VALID SIGHTINGS FOR THIS VESSEL.

VESSEL SUMMARY...

TIME = 35.075 SECONDS.

SWEEP WIDTH SUMMARY TABLE FOR ALL PARAMETERS

TARGETS...LARGE VESSELS

ALTITUDES (IN FEET) ARE CLASSED AS FOLLOWS ... (0) 0 TO 1000, (1) 1000 TO 2000, (2) 2000 TO 3000,

PARAMETERS ARE CLASSED AS FOLLOWS... (0) WIND VELOCITY, (1) SWELL HEIGHT, (2) CLOUD COVER, (3) VISIBILITY,

ALTITUDE CLASS	0	1	2	3	VESSEL ALL
0	1.741E 01	1.820E 01	1.957E 01	1.537E 01	1.686E 01
1	1.541E 01	1.474E 01	1.543E 01	1.447E 01	1.592E 01
2	1.967E 01	1.827E 01	1.335E 01	1.344E 01	1.490E 01
ALL	1.683E 01	1.680E 01	1.600E 01	1.584E 01	1.749E 01

NUMBER OF SIGHTINGS...

ALTITUDE CLASS	0	1	2	3	VESSEL ALL
0	5.300E 01	5.100E 01	1.900E 01	4.900E 01	5.700E 01
1	8.800E 01	8.000E 01	6.700E 01	7.700E 01	9.500E 01
2	3.400E 01	3.100E 01	2.900E 01	3.200E 01	3.900E 01
ALL	1.750E 02	1.620E 02	1.150E 02	1.580E 02	1.910E 02

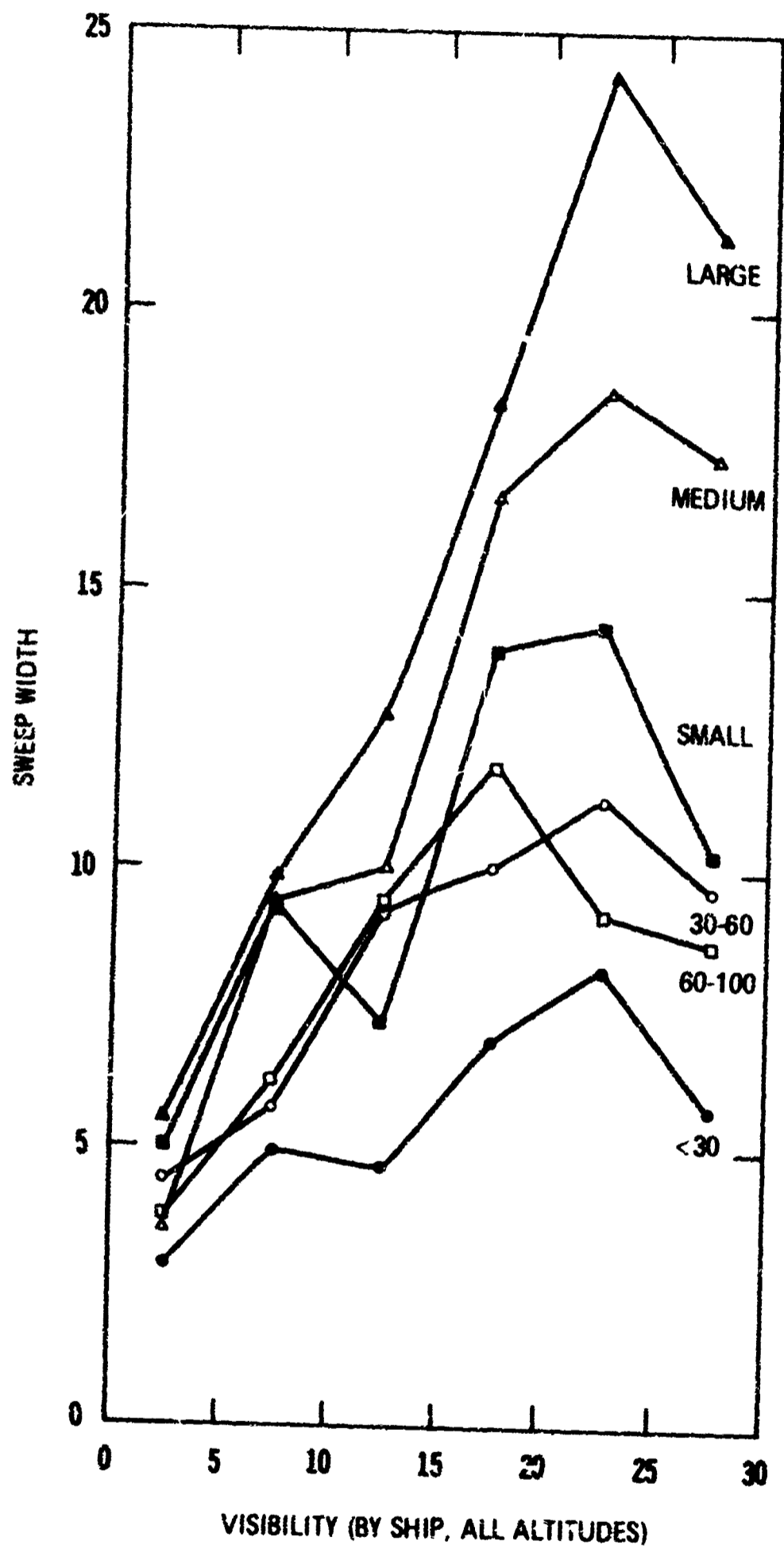
NOTE...

NUMBERS IN LAST COLUMN (ALL) ARE NOT BASED ON PARAMETER COLUMNS, BUT ARE BASED ON ALL VALID SIGHTINGS FOR THIS VESSEL.

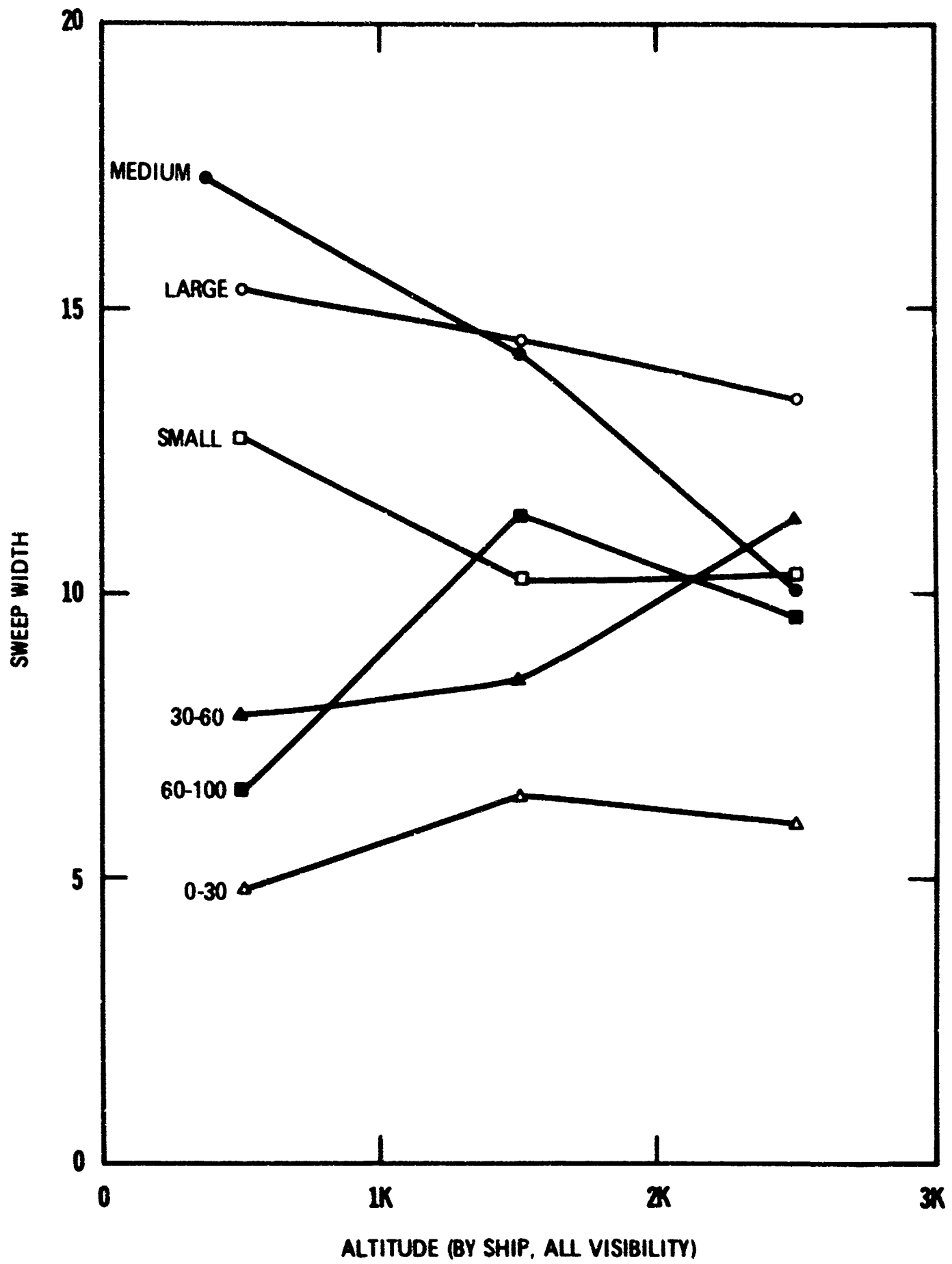
VESSEL SUMMARY...

TIME = 35.926 SECONDS.

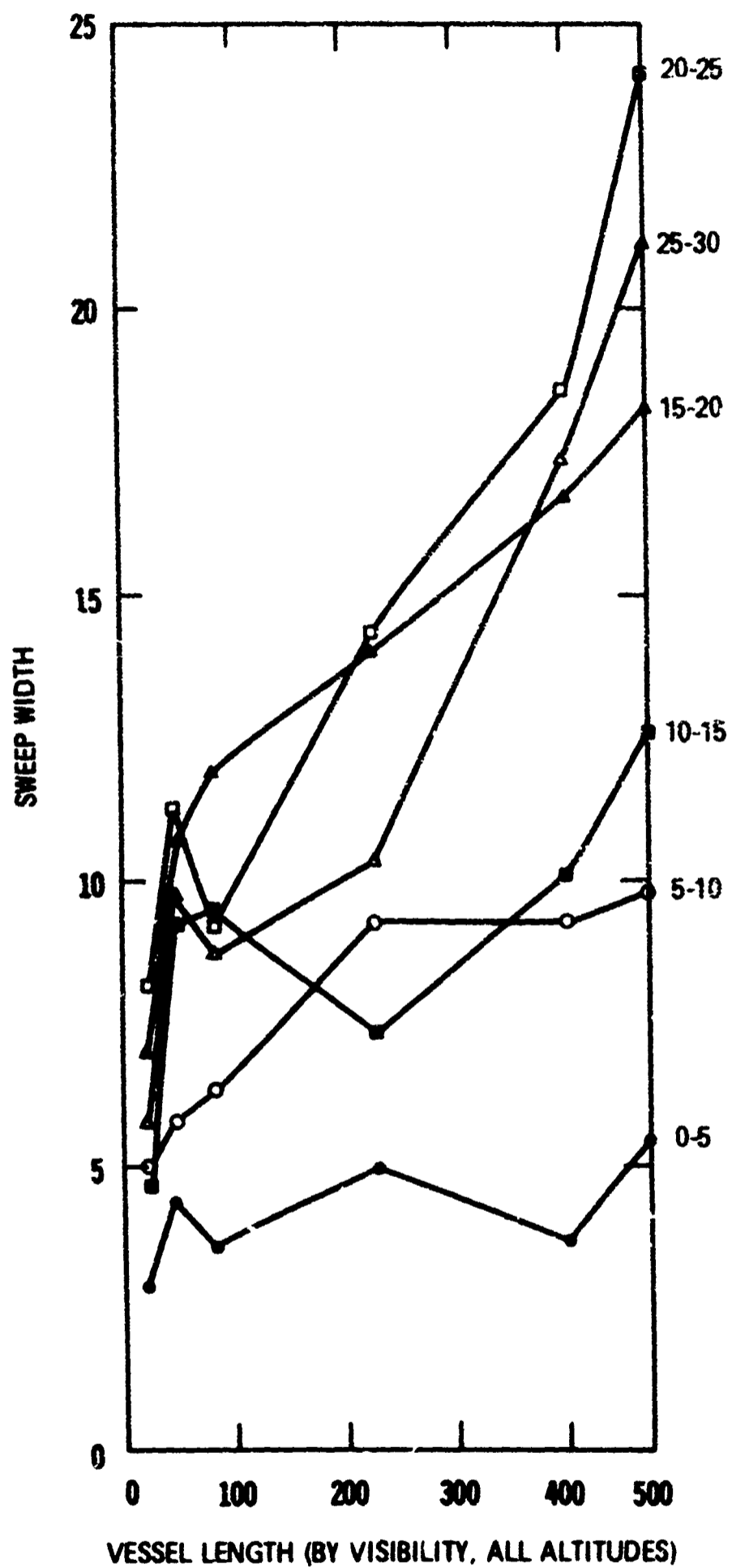
APPENDIX G



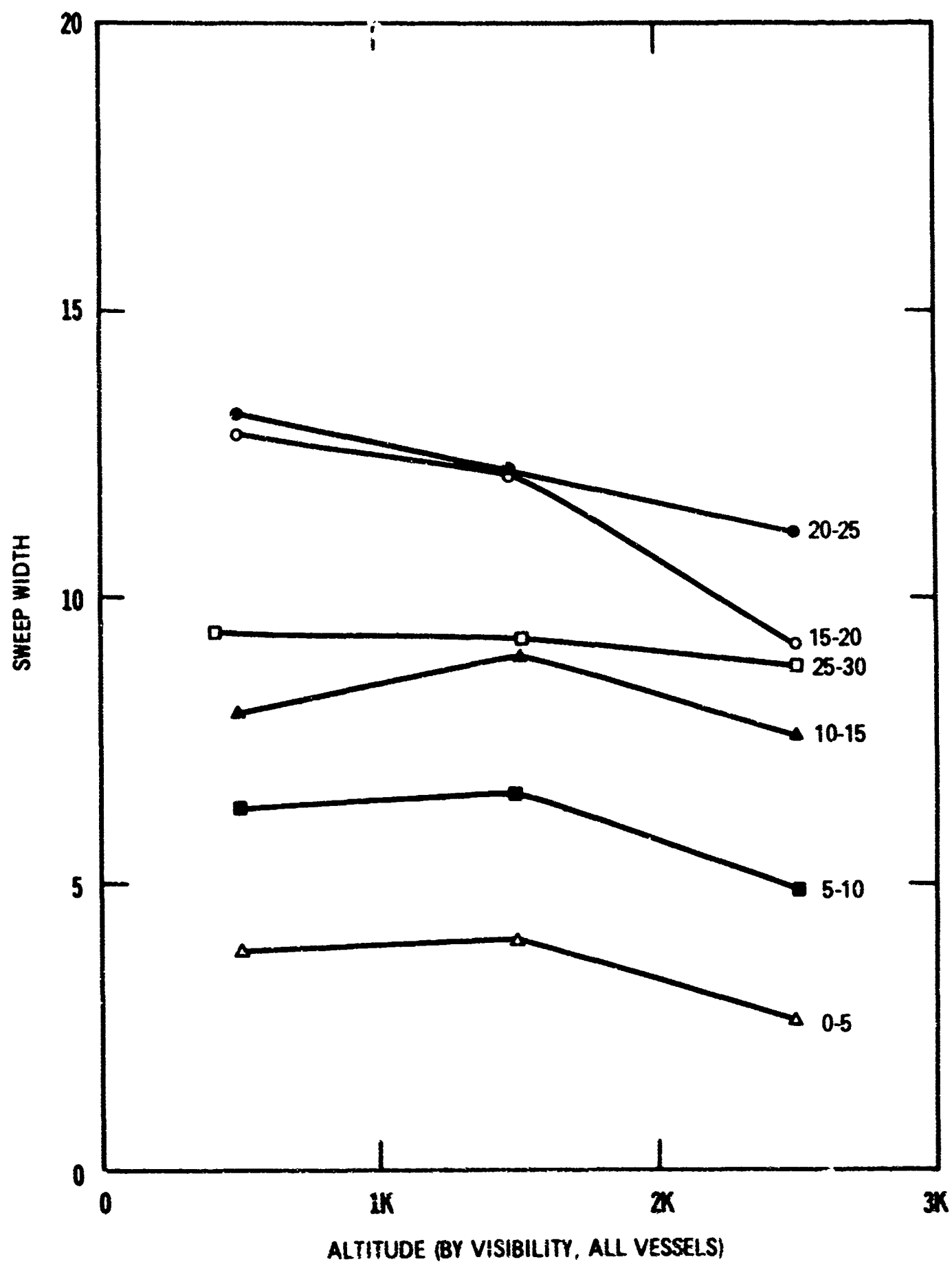
APPENDIX G (Con't.)



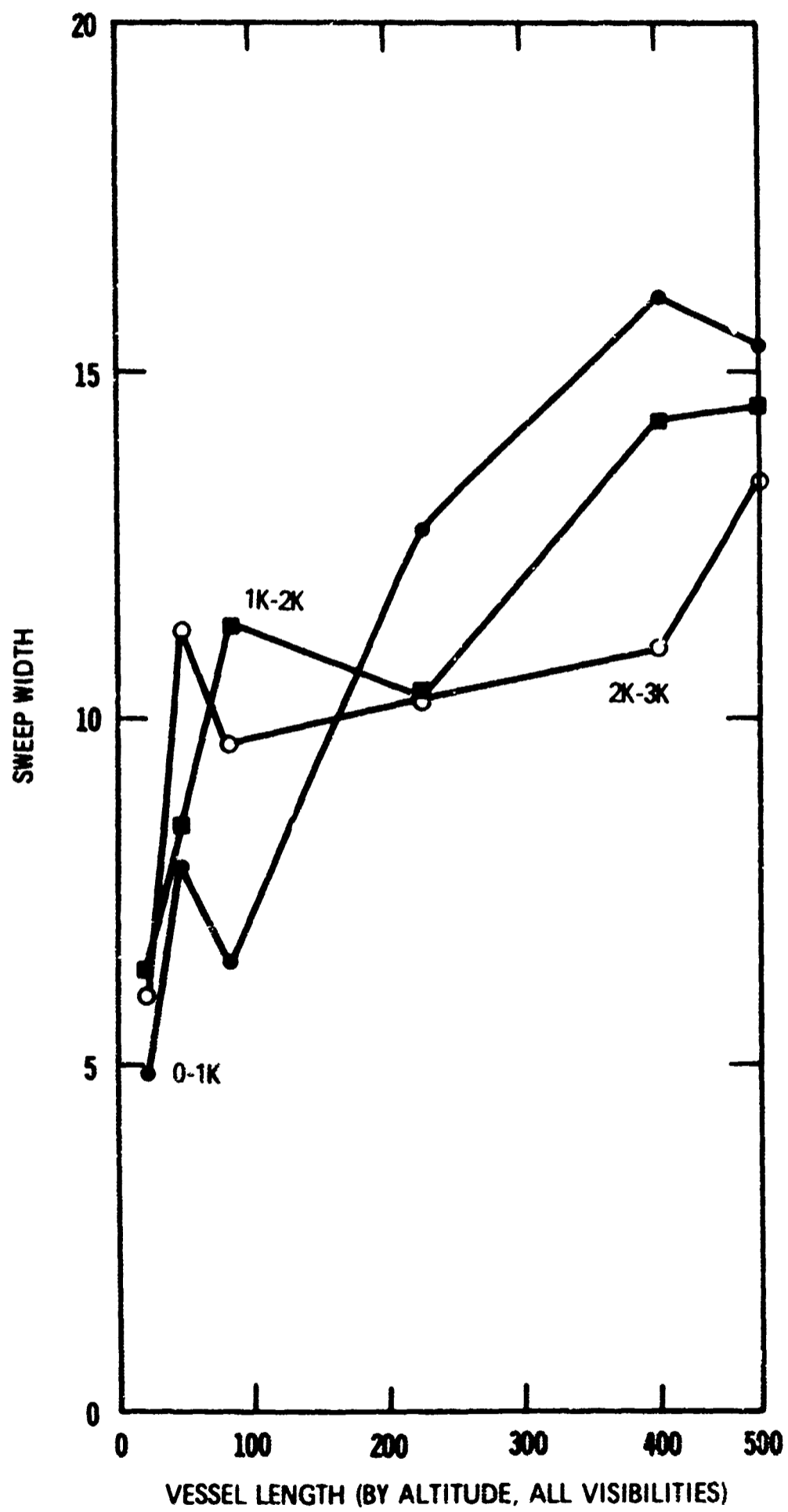
APPENDIX G (Con't.)



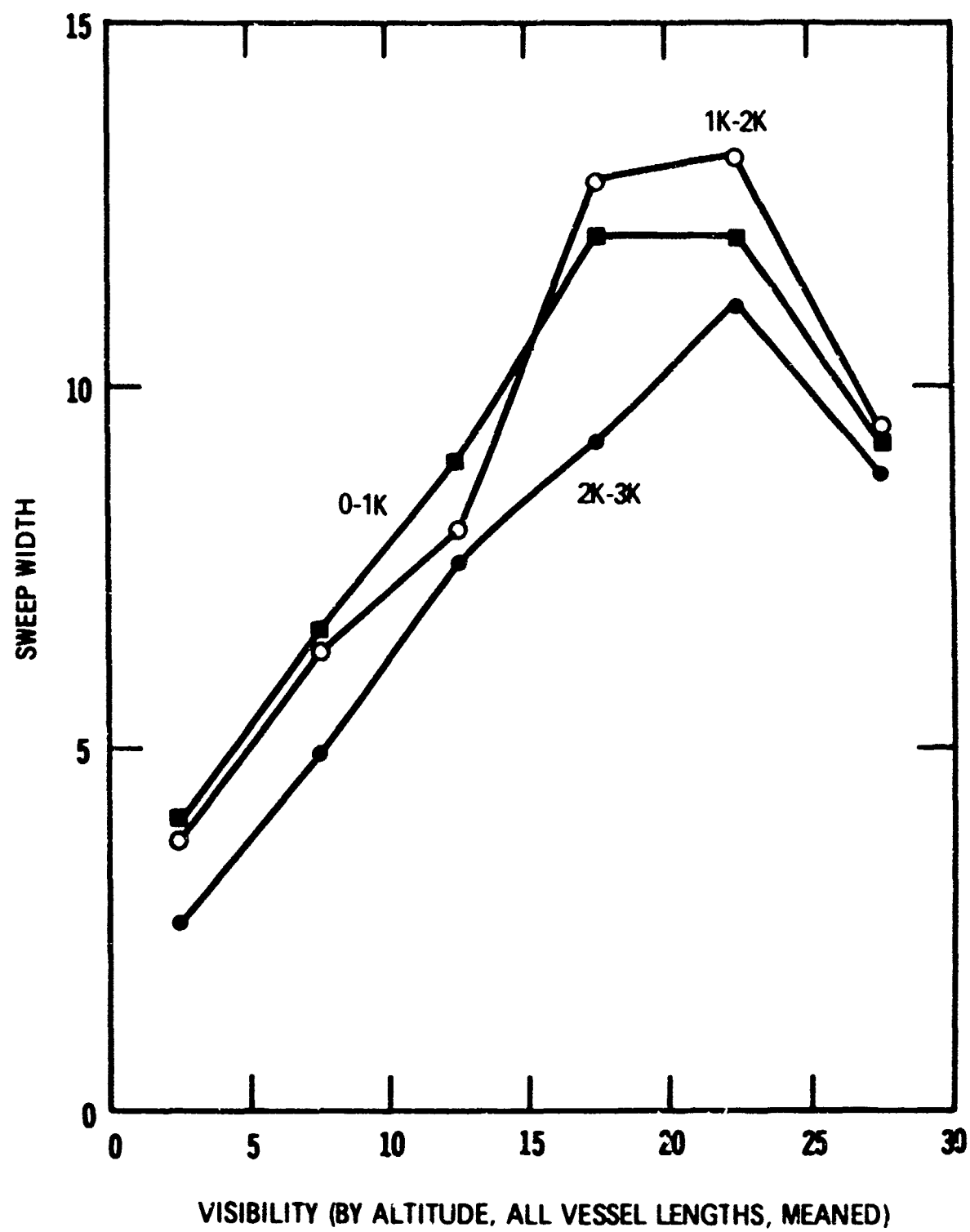
APPENDIX G (Con't.)



APPENDIX G (Con't.)



APPENDIX G (Con't.)



APPENDIX H

SWEEP WIDTH ANALYSIS FOR U. S. COAST GUARD

BY

VISIBILITY LABORATORY
UNIVERSITY OF CALIFORNIA
SAN DIEGO, CALIFORNIA 92152

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REGRESSION ON
LOG SHIP LENGTH
LOG VISIBILITY
LINEAR ALTITUDE

SWEEP WIDTH, W, FOR VISUAL SEARCH

Values for W given in Nautical Miles - Small Boats Less Than 30 Feet

HUNDREDS	SURFACE	5	10	20	30
IFT. ALT.					
IVISIBIL-					
ITY, MI.					
1	.6	1.4	2.3	4.0	5.7
3	2.8	3.4	4.0	5.3	6.6
5	3.8	4.3	4.9	5.9	7.0
10	5.2	5.6	6.0	6.8	7.5
15	6.0	6.3	6.6	7.2	7.8
20	6.6	6.9	7.1	7.6	8.1
30	7.4	7.6	7.9	8.1	8.4
40	8.0	8.1	8.2	8.4	8.6
50	8.5	8.5	8.5	8.7	8.8

SWEEP WIDTH, W, FOR VISUAL SEARCH

Values for W given in Nautical Miles - Small Boats 30 to 60 Feet

HUNDREDS	SURFACE	5	10	20	30
IFT. ALT.					
IVISIBIL-					
ITY, MI.					
1	.3	.2	.7	1.7	2.8
3	3.3	3.6	3.9	4.4	5.0
5	4.9	5.1	5.3	5.7	6.0
10	7.2	7.3	7.3	7.4	7.4
15	8.5	8.5	8.4	8.4	8.3
20	9.5	9.4	9.3	9.1	8.9
30	10.8	10.6	10.4	10.1	9.7
40	11.7	11.5	11.3	10.8	10.3
50	12.5	12.2	11.9	11.3	10.7

APPENDIX H (Con't.)

SWEEP WIDTH, W, FOR VISUAL SEARCH Values for W given in Nautical Miles - Small Boats 60 to 90 Feet

HUNDREDS	SURFACE	5	10	20	30
FEET, ALT.					
VISIBILITY, MI.					
1	2.9	2.6	2.3	2.3	1.9
3	3.6	3.4	3.7	3.9	4.0
5	5.7	5.6	5.5	5.5	5.4
10	8.5	8.3	8.1	7.7	7.4
15	10.1	9.9	9.5	9.1	8.5
20	11.3	11.0	10.6	10.0	9.3
30	12.9	12.5	12.1	11.3	10.5
40	14.1	13.5	13.2	12.2	11.3
50	15.0	14.5	14.0	13.0	11.9

SWEEP WIDTH, W, FOR VISUAL SEARCH Values for W given in Nautical Miles - Small Vessels Less Than 5,000 Tons

HUNDREDS	SURFACE	5	10	20	30
FEET, ALT.					
VISIBILITY, MI.					
1	2.0	2.2	2.4	2.7	3.0
3	4.2	3.9	3.5	2.7	1.9
5	7.1	6.7	6.2	5.2	4.2
10	11.1	10.5	9.9	8.6	7.3
15	13.4	12.7	12.0	10.5	9.1
20	15.1	14.3	13.5	11.9	10.4
30	17.4	16.5	15.7	13.9	12.2
40	19.0	18.1	17.2	15.3	13.5
50	20.3	19.3	18.4	16.4	14.5

APPENDIX H (Con't.)

SWEEP WIDTH, W, FOR VISUAL SEARCH
Values for W given in Nautical Miles - Medium Vessels (5,000 to 10,000 Tons)

HUNDREDS	SURFACE	5	10	20	30
IFT. ALT.					
IVISIBIL- ITY, MI.					
1	2.7	3.1	3.2	4.4	5.2
3	4.6	4.0	3.3	2.0	.7
5	8.0	7.2	6.2	5.0	3.5
10	12.6	11.7	10.9	9.0	7.2
15	15.3	14.3	13.3	11.4	9.4
20	17.2	16.1	15.1	13.0	10.9
30	19.9	18.9	17.5	15.4	13.1
40	21.8	20.5	19.4	17.1	14.7
50	23.2	22.0	20.9	18.3	15.9

SWEEP WIDTH, W, FOR VISUAL SEARCH
Values for W given in Nautical Miles - Large Vessels (Over 10,000 Tons)

HUNDREDS	SURFACE	5	10	20	30
IFT. ALT.					
IVISIBIL- ITY, MI.					
1	2.9	3.4	3.9	4.8	5.8
3	4.7	4.1	3.3	1.8	.4
5	8.2	7.4	6.5	4.9	3.3
10	13.0	12.0	11.1	9.1	7.2
15	15.8	14.9	13.7	11.6	9.5
20	17.8	16.7	15.5	13.3	11.1
30	20.6	19.4	18.2	15.8	13.4
40	22.5	21.3	20.1	17.5	15.0
50	24.1	22.8	21.5	18.9	16.3

APPENDIX I

Table I. Suggested Sweep Width

LESS THAN 30 FT.

Alt. 100 ft.	Vis (Miles)				
	Surface	5	10	20	30
1	0	0	0	0	0
3	2.5	2.0	2.3	1.8	0.4
5	2.7	2.2	2.7	3.2	3.3
10	3.9	3.5	4.2	4.5	5.8
15	5.2	4.8	5.5	6.7	7.0
20	5.3	5.1	6.2	6.8	7.1
30	5.5	5.9	7.0	7.0	7.1
40	5.6	6.0	7.1	7.1	7.2
50	5.7	6.0	7.2	7.2	7.3

30 FT. - 60 FT.

Alt. 100 ft.	Vis (Miles)				
	Surface	5	10	20	30
1	0	0	0	0	0
3	3.3	2.8	2.9	1.8	0.4
5	4.2	3.0	3.6	4.2	3.3
10	6.5	5.5	5.8	6.2	6.5
15	8.5	7.6	7.4	8.4	8.3
20	8.6	8.2	9.0	9.1	8.9
30	8.7	9.5	10.4	10.1	9.7
40	8.9	10.0	11.0	10.8	10.3
50	9.0	10.0	11.9	11.3	10.7

60 FT. - 90 FT.

Alt. 100 ft.	Vis (Miles)				
	Surface	5	10	20	30
1	0	0	0	0	0
3	3.6	3.2	3.2	1.8	0.4
5	5.0	4.2	4.5	4.7	3.3
10	8.0	7.1	7.3	7.7	7.2
15	10.1	9.9	9.6	9.1	8.5
20	11.3	11.0	10.6	10.0	9.3
30	12.5	12.5	12.1	11.3	10.5
40	13.0	13.0	13.2	12.2	11.3
50	13.5	13.5	14.0	13.0	11.9

SMALL

Alt. 100 ft.	Vis (Miles)				
	Surface	5	10	20	30
1	0	0	0	0	0
3	4.2	3.8	3.2	1.8	0.4
5	7.1	6.7	6.2	4.9	3.3
10	11.0	10.0	9.8	8.6	7.2
15	13.4	12.7	12.0	10.5	9.1
20	15.0	14.3	13.5	11.9	10.4
30	17.0	16.5	15.7	13.9	12.2
40	17.0	17.0	17.2	15.3	13.5
50	20.0	19.3	18.4	16.4	14.5

MEDIUM

Alt. 100 ft.	Vis (Miles)				
	Surface	5	10	20	30
1	0	0	0	0	0
3	4.6	4.0	3.3	1.8	0.4
5	8.0	7.0	6.2	4.9	3.3
10	11.0	10.0	10.2	9.0	7.2
15	14.0	13.0	13.3	11.4	9.4
20	15.0	15.0	15.1	13.0	10.9
30	17.0	17.0	17.0	15.4	13.1
40	17.0	17.0	18.0	17.1	14.7
50	20.0	21.0	20.8	18.3	15.9

LARGE

Alt. 100 ft.	Vis (Miles)				
	Surface	5	10	20	30
1	0	0	0	0	0
3	4.7	4.0	3.3	1.8	0.4
5	8.0	7.0	6.6	4.9	3.3
10	11.0	10.0	10.2	9.1	7.2
15	14.0	13.0	13.7	11.6	9.5
20	15.0	15.0	15.6	13.3	11.1
30	17.0	17.0	17.0	15.8	13.4
40	17.0	17.0	18.0	17.5	15.0
50	20.0	21.0	21.0	18.9	16.3

APPENDIX J

Table II. Suggested Sweep Width (Revised)

LESS THAN 30 FT.

Alt. 100 ft.	Vis (Miles)				
	Surface	5	10	20	30
1	0	0	0	0	0
3	2.5	2.4	2.3	1.8	0.4
5	2.7	2.7	2.7	3.2	3.3
10	3.9	4.0	4.2	4.5	5.8
15	5.2	5.3	5.5	6.7	7.0
20	5.3	5.6	6.2	6.8	7.1
30	5.5	6.2	7.0	7.0	7.1
40	5.6	6.3	7.1	7.1	7.2
50	5.7	6.4	7.2	7.2	7.3

30 FT. - 60 FT

Alt. 100 ft.	Vis (Miles)				
	Surface	5	10	20	30
1	0	0	0	0	0
3	3.3	3.0	2.7	1.8	0.4
5	4.2	4.2	4.2	4.2	3.3
10	6.5	6.2	6.2	6.2	6.5
15	8.5	8.5	8.4	8.4	8.3
20	8.6	8.8	9.0	9.1	8.9
30	8.7	9.5	10.4	10.1	9.7
40	8.9	10.0	11.0	10.8	10.3
50	9.0	10.0	11.9	11.3	10.7

60 FT. - 90 FT.

Alt. 100 ft.	Vis (Miles)				
	Surface	5	10	20	30
1	0	0	0	0	0
3	3.6	3.4	3.2	1.8	0.4
5	5.0	5.0	4.9	4.7	3.3
10	8.0	8.0	7.9	7.7	7.2
15	10.1	9.9	9.6	9.1	8.5
20	11.3	11.0	10.6	10.0	9.3
30	12.5	12.5	12.1	11.3	10.5
40	13.0	13.0	13.2	12.2	11.3
50	13.5	13.5	14.0	13.0	11.9

SMALL

Alt. 100 ft.	Vis (Miles)				
	Surface	5	10	20	30
1	0	0	0	0	0
3	4.2	3.8	3.2	1.8	0.4
5	7.1	6.7	6.2	4.9	3.3
10	11.0	10.0	9.8	8.6	7.2
15	13.4	12.7	12.0	10.5	9.1
20	15.0	14.3	13.5	11.9	10.4
30	17.0	16.5	15.7	13.9	12.2
40	17.0	17.0	17.2	15.3	13.5
50	20.0	19.3	18.4	16.4	14.5

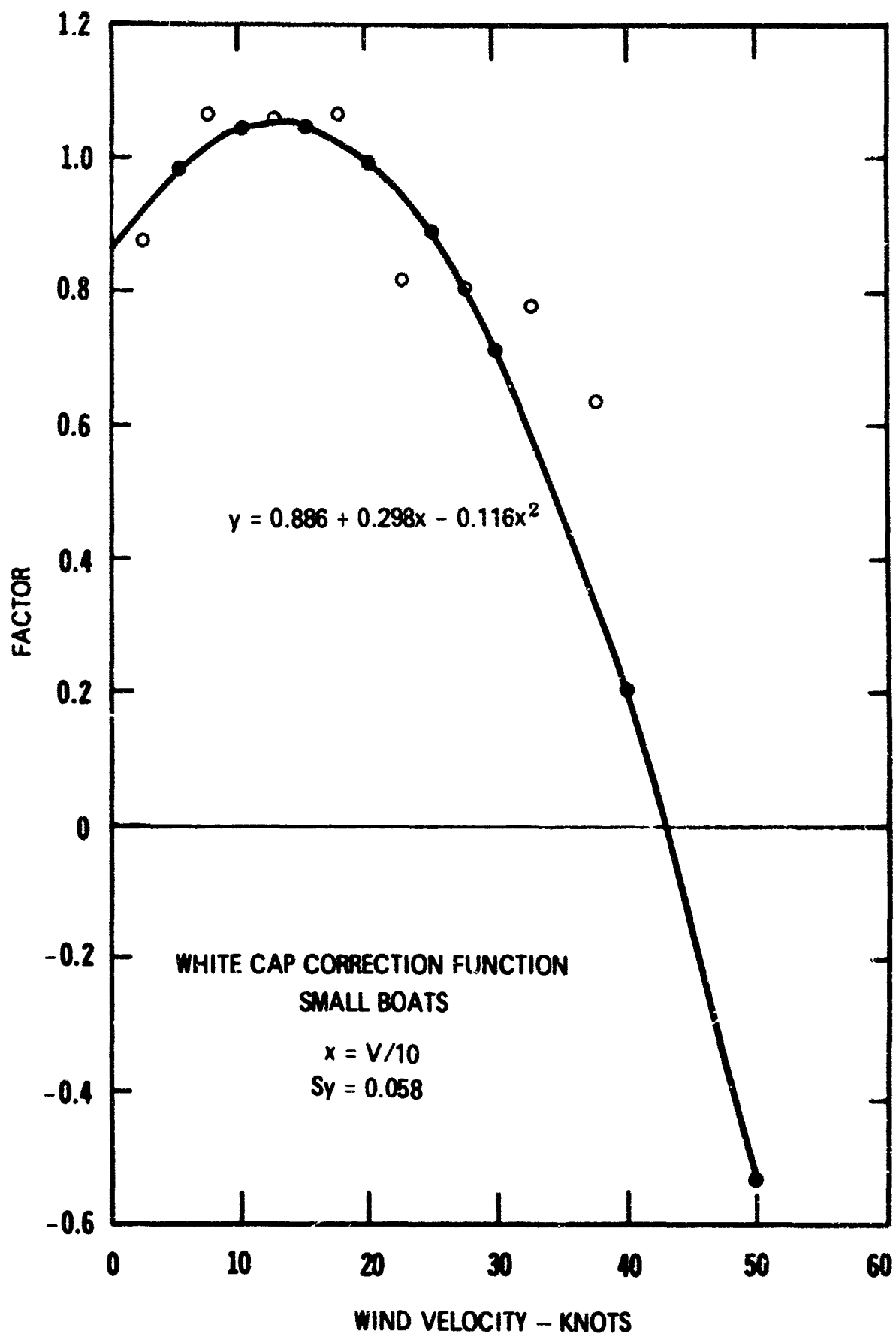
MEDIUM

Alt. 100 ft.	Vis (Miles)				
	Surface	5	10	20	30
1	0	0	0	0	0
3	4.6	4.0	3.3	1.8	0.4
5	8.0	7.0	6.2	4.9	3.3
10	11.0	10.6	10.2	9.0	7.2
15	14.0	13.7	13.3	11.4	9.4
20	15.0	15.0	15.1	13.0	10.9
30	17.0	17.0	17.0	15.4	13.1
40	17.0	17.0	18.0	17.1	14.7
50	20.0	21.0	20.8	18.3	15.9

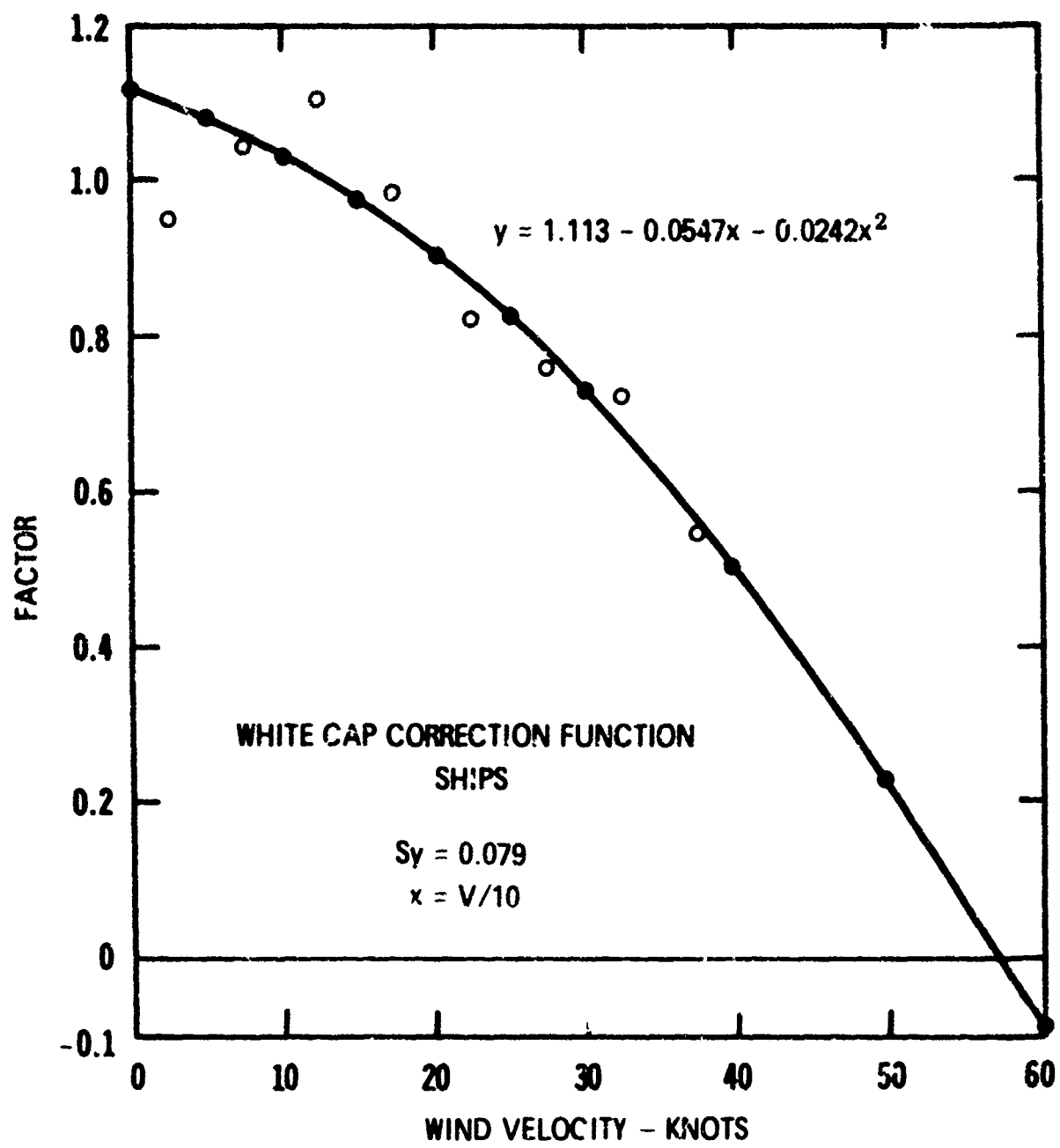
LARGE

Alt. 100 ft.	Vis (Miles)				
	Surface	5	10	20	30
1	0	0	0	0	0
3	4.7	4.0	3.3	1.8	0.4
5	8.0	7.0	6.6	4.9	3.3
10	11.0	10.6	10.2	9.1	7.2
15	14.0	13.9	13.7	11.6	9.5
20	15.0	15.0	15.6	13.3	11.1
30	17.0	17.0	17.0	15.8	13.4
40	17.0	17.0	18.0	17.5	15.0
50	20.0	21.0	21.0	18.9	16.5

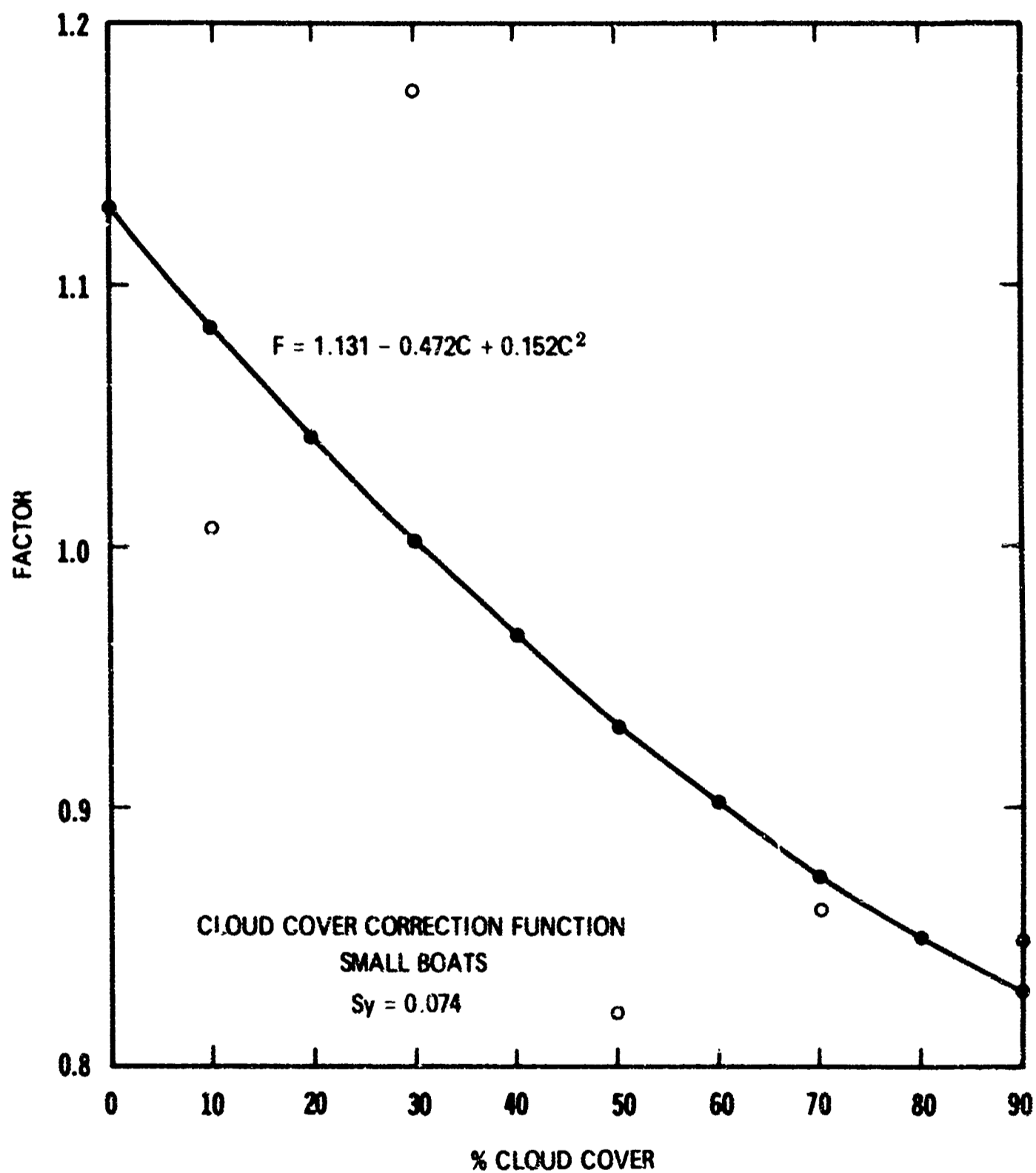
APPENDIX K



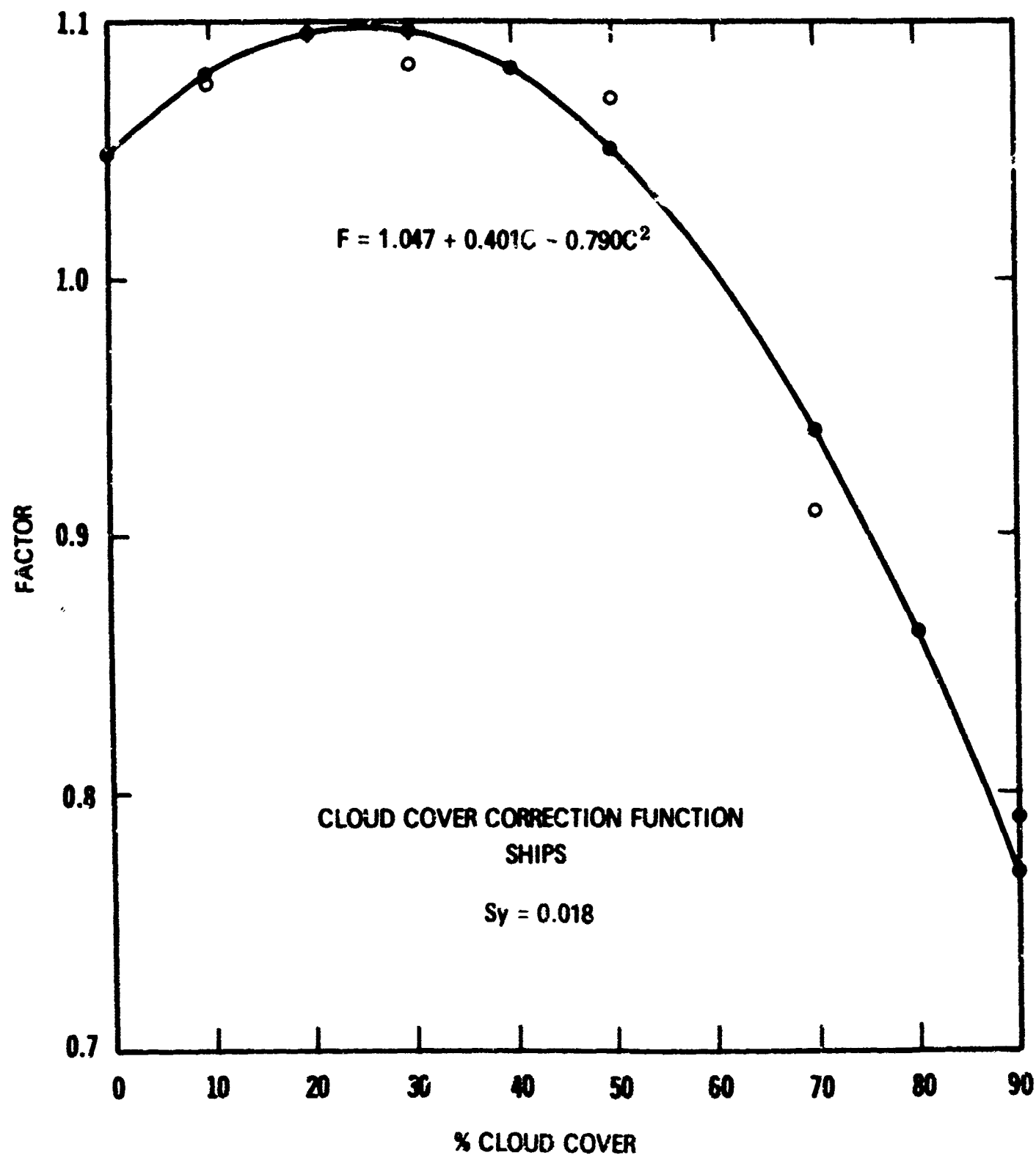
APPENDIX K (Con't.)



APPENDIX L



APPENDIX L (Con't.)



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13. ABSTRACT <p>This study considered 3861 reports of air to sea surface sightings, converted with range and bearing data into lateral range distributions classified by vessel size and altitude, on subclasses of meteorological visibility, wind velocity, swell height, and cloud cover. From these lateral range distributions were developed a revised sweep width table and white cap and cloud cover correction tables for boats and ships.</p>		

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	ROLE	WT	ROLE		ROLE	WT
<p>Search and rescue</p> <p>Sweep width</p> <p>Coast Guard</p> <p>Sighting</p> <p>Lateral range</p> <p>Wind velocity</p> <p>Swell height</p> <p>Air-sea search</p>						